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AUTHOR	Cheng, Wan-Lee
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ABSTRACT

This instructional manual contains 12 learning activity packets for use in a workshop in computer-aided design and drafting (CADD). The lessons cover the following topics: introduction to computer graphics and computer-aided design/drafting; coordinate systems; advance space graphics hardware configuration and basic features of the IBM PC microcomputer and the Epson printer; advanced space graphics system set-up and space tablet calibration; advanced space graphics system package and the coordinate system used; general operating procedures and the major CADD functions; tutorial lesson and the main menu; CADD functions--transformation, file handling, editing, input methods, output methods; and dimensioning and documenting. Each learning activity packet lists prerequisites, purpose, and competencies to be developed and contains information sheets and illustrations, some of which could be used for transparencies. The instructor's guide also contains a suggested method of introducing the lessons, a checklist, references, group activities, and problem keys. (KC)

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COMPUTER AIDED DESIGN:

Instructional Manual

Writer: Dr. Wan-Lee Cheng

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The Industrial Technology Department, University of North Dakota --
High Technology Mobile Laboratory Project Funded by the North Dakota State Board
For Vocational Education -- Mr. Jerry Balistreri and Dr. Myron Bender, Co-Directors

1985

The North Dakota
High Technology Mobile Laboratory Project

Conducted Through
The Department of Industrial Technology
University of North Dakota
Grand Forks 58202

Funded By
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Project Co-Directors:
*Dr. Myron Bender
Department of Industrial Technology
*Mr. Jerry Balistreri
Former North Dakota State
Industrial Arts Supervisor

Specialty Consultant & Writers:
*Dr. Herbert J. Auer
Robotics Instructional Manual
Photovoltaic Instructional Manual
*Dr. Wan-Lee Cheng
Computer-Aided Design
Instructional Manual
*Dr. John W. Sinn
Computer Numerical Control Lathe
Instructional Manual
*Dr. Luvern R. Eickhoff
Laser and Fiber Optics
Instructional Manual

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PROPOSED WORKSHOP ACTIVITIES

5-85 (by: Wan-Lee Cheng)

1. Video Tape: Overview of CAD (lect.)

2. The Learning Activity Packet: Table of Contents (lect.)

3. General Information:
   a. go through the Check List (demo.)
   b. Suggested Method of Introducing the CADD Lessons (lect.)
   c. examine the system set-up (P.54, P.55) (demo.) (do calibration)
   d. start the system (P.74-2), and general operating procedures (P.73, P.74) (demo.)
   e. software package (P.65, P.66) (lect.)
   f. disk protection and important considerations (P.74-7, P.79) (lect.)
   g. hardware configuration (P.37) (lect.)

4. ASG Coordinate System (P.67 to P.70) (lect.)

5. Make Back-up Copies (P.74-3) (lab.)

6. Format a data disk (P.74-4) (lab.)

7. ASG Demonstrations (P.74-5, P.74-6) (lab.)

8. Tutorial Lesson (P.81 to P.84) (demo.)

9. The Main MENU (P.108 to P.110) (lect.)

10. The INPUT functions (P.133 to P.151) (demo.)

11. Laboratory Activities:
    a. Group 1--INPUT, 3-D: rect. cube, 2-D: Prob. 1
       Group 2, 3, 4--T-FORM, FILES (not EDIT), LABEL
    b. Group 2--INPUT, 3-D: disk, 2-D: Prob. 2
       Group 1, 3, 4--T-FORM, FILES (not EDIT), LABEL
    c. Group 3--INPUT, 3-D: cone, 2-D: Prob. 3
       Group 1, 2, 4--T-FORM, FILES (not EDIT), LABEL
    d. Group 4--INPUT, 3-D: hollow cylinder, 2-D: Prob. 4
       Group 1, 2, 3--T-FORM, FILES (not EDIT), LABEL

    * T-FORM, FILES, and LABEL practices are individual hands-on exercises. Each individual should follow the LAP units and work through those units. OUTGRAPH disk will be used.

    * INPUT practice, 3-D Tablet assignment, and 2-D Tablet assignment are group projects. Each individual should SAVE the drawings on the DATA disk, PLOT the 3-D drawing, and PRINT out the 2-D drawing.

12. Discuss the CADD 1 and the CADD 2

Dr. Wan-Lee Cheng (701) 777-2197
Department of Industrial Technology
University of North Dakota
May, 1985

Computer Aided Design/Drafting

Suggested method of introducing the CADD lessons
Checklist

CADD 1: Introduction to computer Graphics and Computer Aided Design/Drafting

1. What is computer graphics
2. Computer graphics applications
3. CADD system, types
4. CADD applications
5. CADD levels
6. Types of CADD processing
7. CADD functions and advantages
8. Computer and CADD terminaology
9. Hardware and Software

CADD 2: Coordinate Systems

1. Cartesian coordinates, 2-D and 3-D
2. Polar coordinates

CADD 3: Advanced Space Graphics Hardware Configuration and Basic Features of the IBM PC Microcomputer and the Epson Printer

1. ASG system configuration
2. IBM PC keyboard, general key functions and commands
3. Epson MX-80 printer

CADD 4: Advanced Space Graphics System set-up and Space TAblet Calibration

1. Systems set-up
2. Tablet Calibration

CADD 5: Advanced Space Graphics system Package and the Coordinate System Used

1. Details of the three disks
2. ASG coordinate systems (2-D, 3-D)
3. Tablet, User and Screen coordinates
4. Rotation direction

CADD 6: General Operating Procedures and the Major CADD Functions

1. How to start the IBM PC
2. Making back-up copies
3. Format data disks
4. ASG Demonstrations
5. How to protect floppy diskette
6. Copying Files
7. Important considerations
8. Major function tree

CADD 7: Tutorial Lesson and the Main Menu

1. Tutorial lesson
2. The Main Menu
3. Active drawing indexing

CADD 8: CADD Function - Transformation (T-form)

1. Scaling
2. Rotating
3. Moving
4. Orthgraphic projection
5. Perspective views
6. Zoom in and out

CADD 9: CADD function - File Handling and Editing (files)

1. Loading
2. Choosing
3. Editing
4. Erasing

CADD 10: CADD function - Input Methods (Input)

1. Space tablet (3-D)
2. MCS tablet (2-D)
3. Keyboard data entry
4. Grid selection
5. Scale selectioin
6. Arc construction
7. Doubling

CADD 11: CADD function - Output Methods(Output)

1. Plotting
2. Printing
3. Data listing

CADD 12: CADD function - Dimensioning and Documenting (Label)

1. Adding texts
2. Auto-dimensioning (distance, angle)
3. Modifying texts and/or dimensions
4. Label filing

References
Complete function tree diagram
Group Activities
3-D problem keys

CHECK LIST

Before you start to use the CADD system, please check:

A. Hardware:

1. IBM PC & Keyboard (also power cord and keyboard connection)
2. RGB Monitor
3. Epson Printer
4. Houston DMP-29 Plotter
5. 3-D Space Tablet
6. MCS 2-D Tablet
7. Cables: IBM to Monitor (also a power cord)
   IBM to 3-D Tablet
   IBM to 2-D Tablet (also a power supply)
   IBM to Printer (also a power cord)
   IBM to Plotter (also a power cord)
8. Plotter Pens

B. Software:

1. 2 - IBM IBM DOS disks
2. 2 - ASG INGRAPH disks
3. 2 - ASG OUTGRAPH disks
4. 2 - ASG UTILITIES disks

   (they are housed in two disk file holders)

C. Documentation:

1. A copy of OWNERS'S MANUAL
2. A copy of CADD LEARNING ACTIVITY PACKET

D. Models for 3-D Objects:

1. Wood rectangular cube
2. Styrofoam disk
3. Styrofoam cone
4. Hollow cylinder

E. Teaching Tool:

   1. 3-D axis model

F. Materials you should provide:

   1. Plotter paper
   2. Blank disks (make sure you format them first)

5-85

Suggest Method of Introducing the CADD Lessons

1. Go through the check list and make sure that hardware, software, documentations, and 3-D models are complete.

2. Examine the system set-up (p. 54, steps A and B)

3. Start the system. (p. 74-2)

4. Inspect the provided diskettes: INGRAPH, OUTGRAPH, and UTILITY by following the "ASG Demonstrations" procedures (p. 74-5). (Generally speaking, for INGRAPH and OUTGRAPH, you only need to perform action steps 1 to 22.)

5. If the provided diskettes function properly, you should make your own back-up copies for all three disks. (p. 74-3)

6. Format one to two data disks. (p. 74-4)

   * FROM THIS POINT ON, YOU SHOULD ONLY USE YOUR OWN BACK-UP DISKETTES.

7. Review the learning activity packet along with the owner's manual yourself.

8. Follow the LAPs and practice them by yourself, especially CADD 4 to CADD 12.

9. Briefly discuss the CADD 1, CADD 2 and CADD 3. (Make your own judgement in terms of the amount of coverage).

10. Demonstrate the CADD 4 (optional) and actually calibrate the 3-D Space Tablet (must).

11. Discuss the CADD 5 (Use your judgement in terms of the amount you are going to cover.)

12. In CADD G, go through the ASG Demonstrations. (Page 74-5) Review the "How to Protect Floppy Diskette" (Page 74-7), and the "Several Important Considerations" (Page 79) with your students.

13. Demonstrate the CADD 7

14. Demonstrate the CADD 8 to CADD 12

15. Divide students to groups, assign each group to practice one major function.

    (If time permits, each group can go through all functions).

16. Assign group activities. Each group should practice one 3-D drawing generation and a 2-D problem.

17. It is suggested that at least students will have a chance to go through the "ASG Demonstrations" and the "Tutorial Lessons".

18. If you have any problem, please call Dr. Wan-Lee Cheng. (701) 777-2249 or (701) 777-2197.

UNIVERSITY OF
NORTH DAKOTA
DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 1

LAP TITLE: Introduction to Computer Graphics and Computer Aided Design/Drafting

PREREQUISITE LAP (S) : Mechanical Drafting Background

LAP PURPOSE: To introduce computer aided design/drafting regarding basic concepts, terminology,system elements, hardware, software functions, and applications.

COMPETENCIES TO BE DEVELOPED:

1. To develop basic understanding of the CADD functions.
2. To understand the role of CADD in today and future industry.
3. To define common computer and CADD related terms.
4. To identify common CADD hardware devices and software elements.
5. To describe CAD applications and advantages.

COMPUTER GRAPHICS

DEFINITION: THE USE OF COMPUTERS IN THE CREATION AND MODIFICATION OF PICTURES. IT IS AN IMAGE GENERATION PROCESS.

COMPUTER GRAPHICS:
- DATA STRUCTURES
- GRAPHIC ALGORITHMS
- LANGUAGES

DATA STRUCTURES: Coordinates (X,Y), (X,Y,Z) or (θ,R)

Geometric Functions; Points, Lines, Circles, Ellipses, Polygons, etc.

Mathematical operations: Equations, trigonometric functions

GRAPHIC ALGORITHMS: A set of simple rules for the solution of a mathematically expressed problem, or for evaluating a function. ie.: turn on the pixel, move, draw, scale up, etc.

LANGUAGES: Computer understandable instructions. i.e. Direct the computer to obtain data and operate graphic algorithms. Provide output, storage, etc.

APPLICATIONS OF COMPUTER GRAPHICS

ENGINEERING GRAPHICS: COMPUTER AIDED DESIGN/DRAFTING (CADD)

ARCHITECTURAL GRAPHICS

BUSINESS AND SCIENTIFIC GRAHICS

STATISTICAL GRAPHICS

MAPPING

VISUAL ARTS AND DESIGN

ANIMATION

ADVERTISEMENT

ELECTRONIC GAMES

WHAT IS A CADD SYSTEM

--NOT JUST HARDWARE

--NOT JUST SOFTWARE

--INTEGRATED--PEOPLE, COMPUTER, SOFTWARES, OTHER HARDWARE.

HARDWARE:

Central Processor
Work Station
Storage
Input
Output

SOFTARE:

Operating System = A special computer program that performs basic functions, such as communications with peripherals, regulating the execution of programs and data file mangement.

APPLICATIONS PROGRAMS = Computer programs that perform specific user - oriented tasks.

ANALYSIS = Finite element analysis, structure analysis stress, strain analysis other engineering design analysis.

DATA BASE MANAGEMENT = Storing and retrieving data control and distribution of data security.

CADD APPLICATIONS

SEGMENT	APPLICATION
AEROSPACE	Lofting, structure, hydraulics configurations
ARCHITECTURAL	Plan views, sections, elevations, structural, heating, plumbing, electrical.
AUTOMOTIVE	Kineatics, hydraulics, steering, body, tires, wiring, suspension.
CIVIL	Mapping, highway, utilities, drain contour.
ELECTRICAL	Power control schematics, connection diagrams.
ELECTRONIC	Schematic diagrams, printed circuit, integrated circuit.
MECHANICAL	Machine design, CNC processes, sheet-metal layout, working drawings, tooling and fixtures.
PIPING	Line schematics, control system.

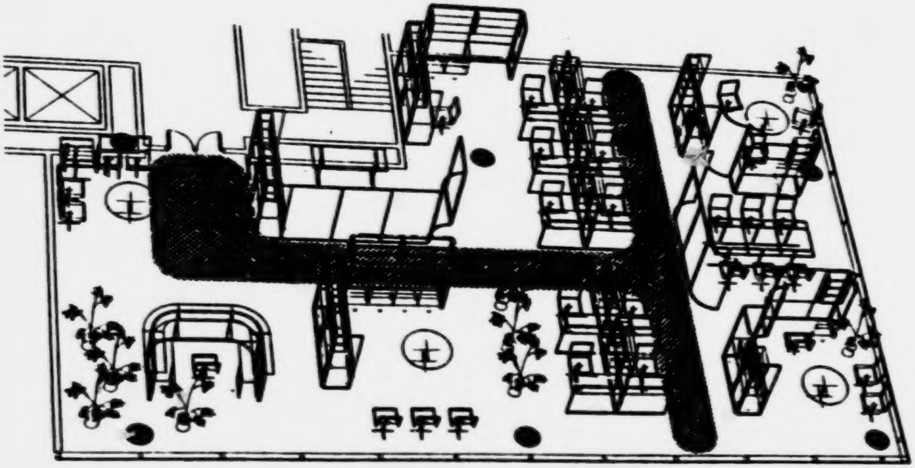

FIGURE 4-25 Computer-drawn architectural sample. (Courtesy of Applicon Incorporated.)

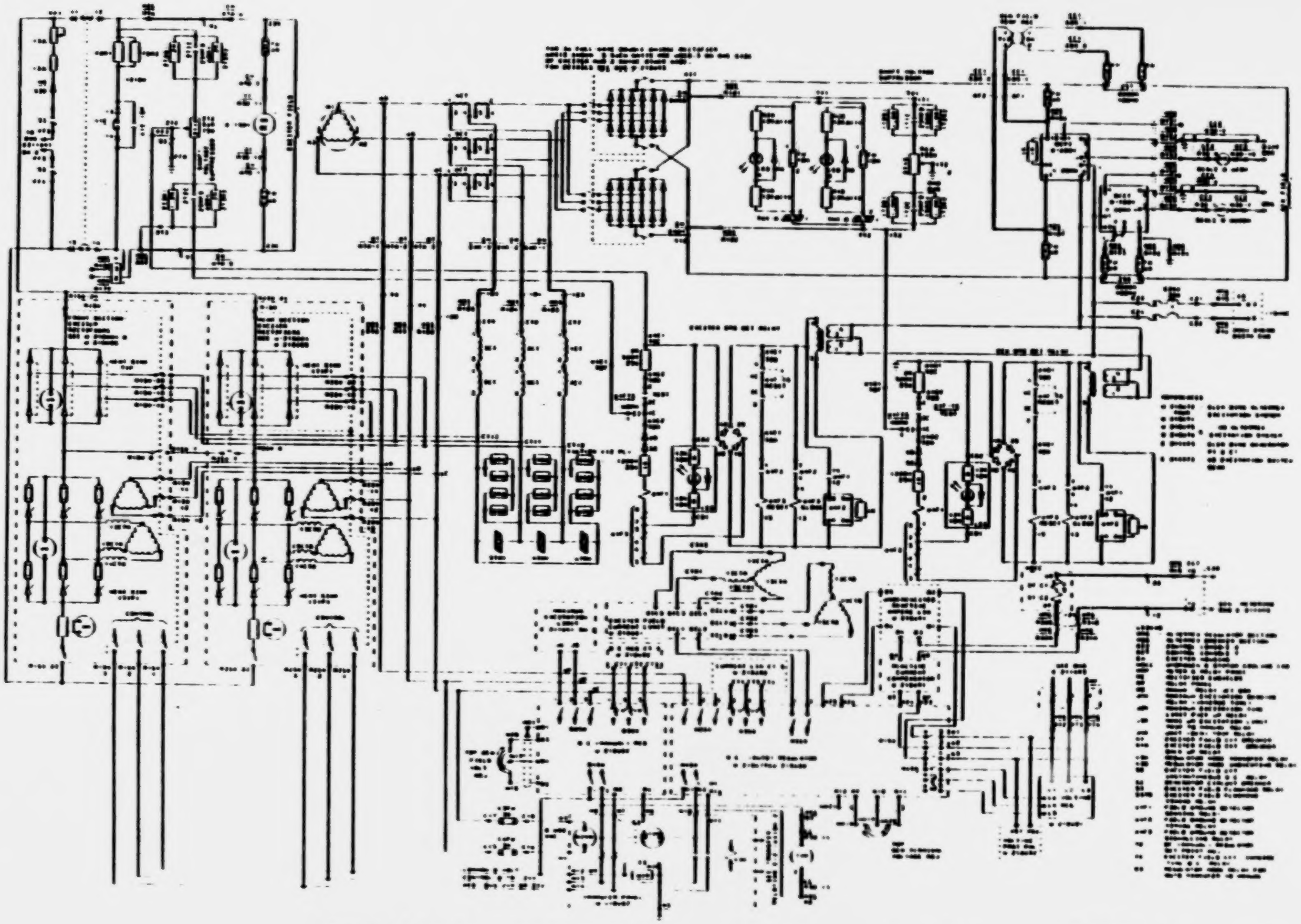

FIGURE 4-32 Computer-drawn electronics sample. (Courtesy of Applicon Incorporated.)

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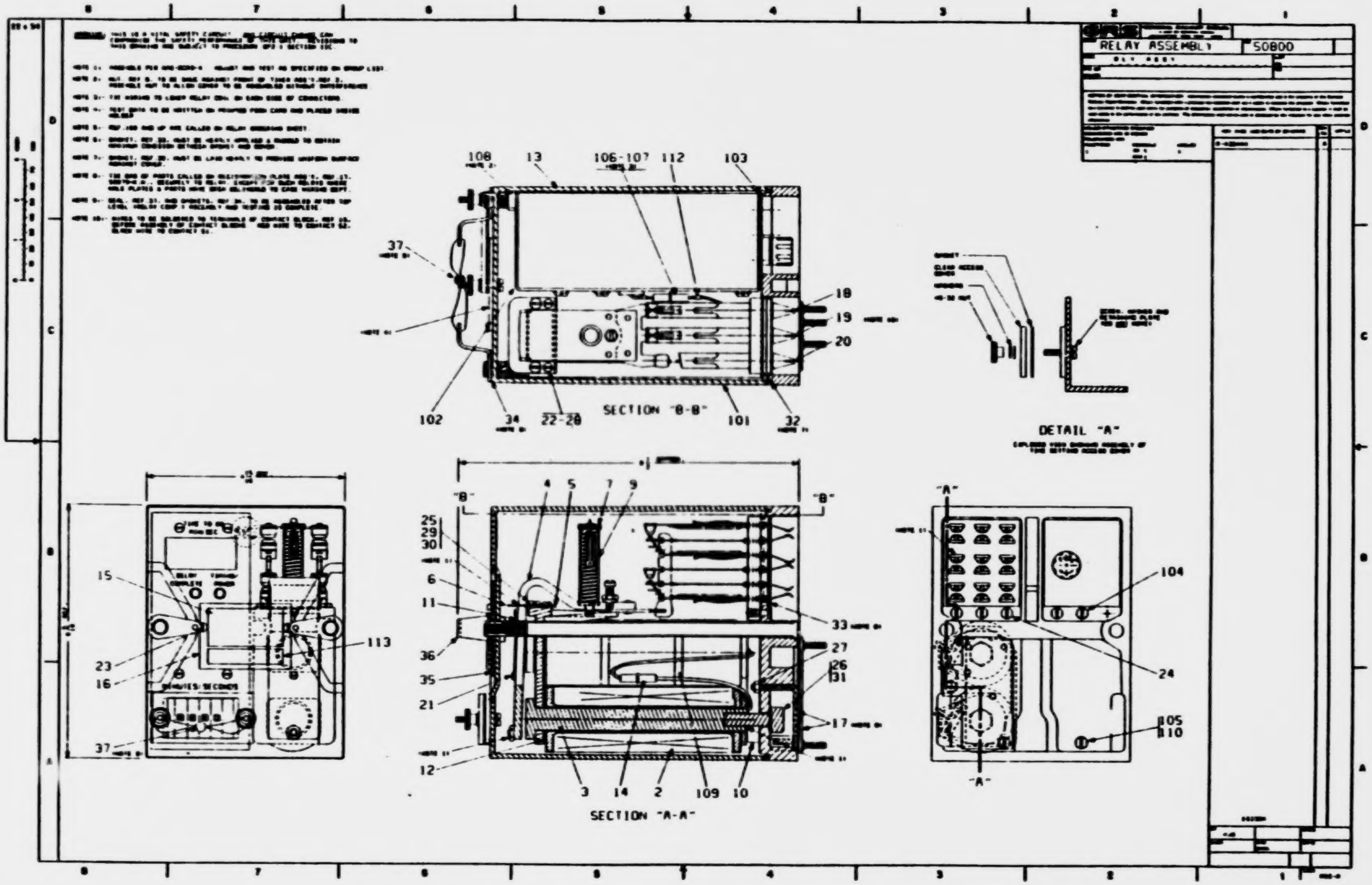

FIGURE 4-40 Computer-drawn mechanical sample. (Courtesy of General Railway Signal Company.)

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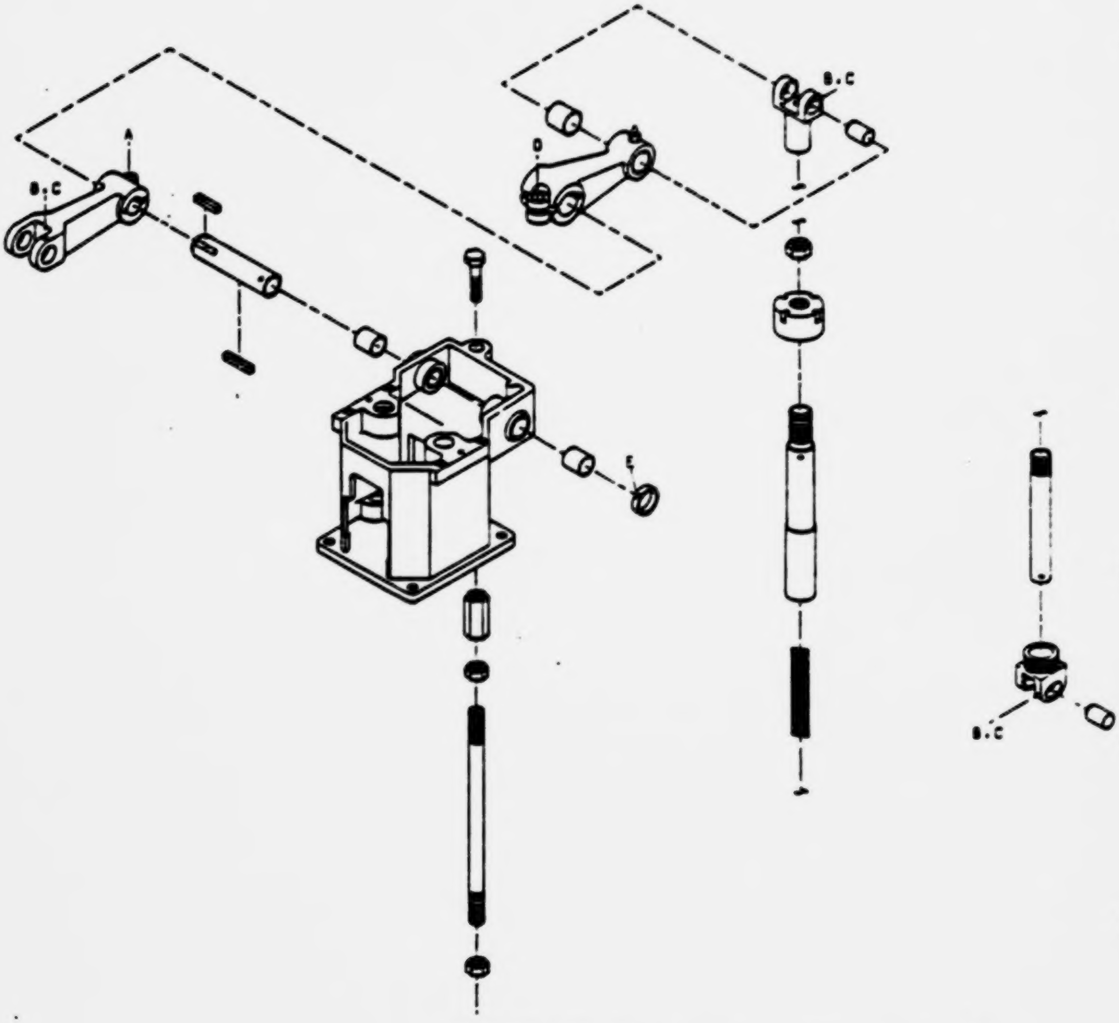

FIGURE 4–53 Computer-drawn pictorial sample. (Courtesy of Phillips Petroleum.)

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TYPES OF CADD SYSTEMS

TIME SHARING SYSTEM

STAND ALONE (TURNKEY) SYSTEM

MICRO SYSTEM

LEVELS OF CADD SYSTEMS

COMPUTER AIDED DRAFTING

COMPUTER AIDED DRAFTING/DESIGN

COMPUTER INTEGRATED MANUFACTURING

CADD OPERATIONS

BATCH PROCESSING:	A type of computer processing in which input is followed, often minutes or hours later, by output. The user does not interact with the computer while the processing is taking place.
INTERACTIVE GRAPHICS:	A type of computer processing in which the user interacts with computer during processing.

WHAT CADD SYSTEMS CAN DO

-- PRE-DESIGN

--DESIGN DEVELOPMENT

--CONSTRUCTING DRAWINGS

--DOCUMENTATIONS

--DATA COMMUNICATIONS

SUMMARY OF CADD ADVANTAGES

STANDARDIZATION

REDUCED DRAWING TIME

EASY TO STORE AND RETRIEVE

IMPROVED QUALITY AND QUANTITY

EASY TO MAKE MODIFICATIONS

ANALYTICAL DESIGN

DATA BASES PRODUCTION

LESS COST, HIGHER PRODUCTIVITY, QUALITY ASSURANCE IN A LONG RUN.

IMPORTANT BACKGROUND INFORMATION

I. INPUTS:

KEYBOARD
DIGITIZER
LIGHT PEN
STYLUS
JOYSTICK
TRACK BALL
MOUSE

II. HOST COMPUTER (CPU):

GRAPHIC PROCESS CAPABILITY
MEMORY SIZE
SPEED
PERIPHERALS (INTERFACE)
COMMUNICATION DEVICES

III. OUTPUTS:

GRAPHIC DISPLAY TERMINAL
- A. Vector or line element devices
- B. Raster or pixel element devices

RESOLUTION: The degree of sharpness and clarity that can be presented. (lines or dots per inch.) ie. 128x48, 40x48, 280x192, 640x480, 1024x1024, etc.

HARDCOPY DEVICE:
- A. Printer (dot matrix)
- B. Pen Plotter
  - 1. Drum
  - 2. Flatbed
- C. Electrostatic Plotter
  scanning
- D. Camera Copiers
- E. Laser Scanning

IV. STORAGE AND RETRIEVAL

- Tape Drive and Tape
- Disk Drive and Disk
    - Winchester
    - Floppy

V. WORKSTATION:

- Desk, Chair
- Drafting Table
- File Cabinet

IMPORTANT TERMS

BAUD RATE: ROUGHLY EQUIVALENT TO THE NUMBER OF BITS PER SECOND BEING TRANSMITTED OR RECEIVED IN TLEPROCESSING. APPROXIMATELY EQUAL TO TEN TIMES THE NUMBER OF CHARACTERS PER SECOND.

BIT: A BINARY DIGIT: 0 OR 1: A DIGIT IN THE BASE 2 NUMBER SYSTEM.

BYTE: EIGHT BITS.

COM: COMPUTER OUTPUT MICROFILM. A FORM OF COMPUTER OUTPUT IN WHICH CHARACTERS AND FIGURES ARE PRINTED ON PHOTOGRAPHIC FILM, USUALLY FOR VIEWING WITH A MAGNIFYING VIEWER.

COORDINATES: IN THE CASE OF COMPUTER GRAPHICS, A PAIR OF NUMBERS CORRESPONDING TO A POINT IN THE PLANE, OR A TRIPLET OF NUMBERS, CORRESPONDING TO A POINT IN SPACE.

CPU: CENTRAL PROCESSING UNIT -- THE MAIN CALCULATING SECTION OF A COMPUTER SYSTEM.

CURSOR: 1. A CHARACTER THAT IS DISPLAYED ON A CRT SCREEN INDICATING THE CURRENT POINT OF INPUT OR OUTPUT. 2. A MOVABLE VIEWFINDER ON A DIGITIZER.

DATA BASE: A COLLECTION OF FILES FOR A SPECIFIC PURPOSE.

DIGITIZER: A DEVICE THAT TRACKS THE RELATIVE POSITION OF A CURSOR, FOR THE PURPOSE OF RECORDING THE RELATIVE LOCATIONS OF, FOR EXAMPLE, POINTS ON A MAP.

DISK: IN COMPUTER SYSTEMS, A PLATTER OF A SET OF AXIALLY-CONNECTED PLATTERS COATED WITH A MAGNETIC SUBSTANCE, ALLOWING THE STORAGE OF MAGNETIC CHARGES.

DISK DRIVE: Sometimes used synonymously with disk; occasionally used to refer to the hardware used to access a disk.

DISTRIBUTED INTELLIGENCE: A COMPUTER SYSTEM WITH SEVERAL PROCESSORS.

DRUM PLOTTER: A PLOTTER IN WHICH PAPER IS MOVED DIRECTIONALLY BY A METAL DRUM TO SUPPLY THE MOTION IN ONE AXIS, AND A TRACK-MOUNTED PEN CARRIAGE IN THE OTHER AXIS.

ELECTROSTATIC PRINTER PLOTTER: A COMPUTER OUTPUT DEVICE THAT PRINTS AND PLOTS BY PLACING ELECTROSTATIC CHARES ON SMALL AREAS OF TREATED PAPER, IN THE DESIRED PATTERN, UPON WHICH TONER IS SPREAD AND BAKED.

ELECTROMECHANICAL COORDINATOGRAPH: A DIGITIZER THAT USES ELECTRICAL MEANS TO CONVERT MECHANICAL MOTION INFORMATION INTO COORDINATES.

FILE: A COLECTION OF INFORMATION, USUALLY FOR A SPECIFIC PURPOSE.

FLATBED PLOTTER: A PLOTTER IN WHICH THE PLOTTING MEDIUM IS PLACED ON A FLAT BED, AND THE PEN CARRIAGE MOVES ON A GANTRY THAT SPANS THE TABLE, AND ITSELF TRAVELS THE OTHER AXIS.

GRAPHIC INPUT AND OUTPUT: PUTTING DRAWINGS INTO, OR GETTING DRAWINGS OUT OF, A COMPUTER.

HARD COPY: PAPER OR FILM COMPUTER OUTPUT.

HARDWARE: ALL THE ELCTRICAL AND MECHANICAL COMPONENTS OF A COMPUTER SYSTEM.

IMPACT PRINTER/PLOTTER: A COMPUTER OUTPUT DEVICE THAT USES AN IMPACT MECHANISM, USUALLY TO STRIKE A WIRE DOT MATRIX OR CHARACTER DIE THROUGH A CARBON RIBBON ONTO THE PAPER. These devices can print characters or plot pictures, generally by means of dot patterns.

INTERFACE: IN THE SENSE OF COMPUTERS, AN ELECTRONIC CIRCUIT THAT MATCHES ONE DEVICE TO ANOTHER: AS A PLOTTER INTERFACE TO A COMPUTER.

K: SHORT FOR KILO - GREEK PREFIX MEANING "1,000". GENERALLY USED IN CONJUNCTION WITH A NUMBER, REFERRING TO THE NUMBER OF THOUSANDS OF POSITIONS IN A COMPUTER MEMORY -- FOR INSTANCE, "128K OF MEMORY".

MASS STORAGE: DEVICES FOR STORING LARGE QUANTITIES OF DATA IN A COMPUTER SYSTEM: E.G., DISKS AND TAPES.

MEMORY: IN A COMPUTER, MEMORY REFERS TO THE PART OF THE CPU WHERE

PROGRAM INSTRUCTIONS FOR CURRENT EXECUTION AND DATA TO BE OPERATED ON ARE.

MICROCOMPUTER: A CPU WITHIN A SINGLE INTEGRATED CIRCUIT, COUPLED TO SOME MEMORY AND INPUT/OUTPUT INTERFACES.

MICROPROCESSOR: AN ENTIRE CPU ON A SINGLE INTEGRATED CIRCUIT.

OUTPUT: WHAT COMES OUT OF A COMPUTER.

PERIPHERAL: ANY INPUT, OUTPUT OR MASS STORAGE DEVICE CONNECTED TO A COMPUTER.

PHOTOPLOTTER: A PLOTTER WITH A LIGHT SOURCE IN ITS PLOTTING HEAD FOR PLOTTING ON LIGHT-SENSITIVE FILM.

PLOTTER: A DEVICE THAT TRANSLATES ELECTRICAL IMPULSES REPRESENTING RELATIVE LOCATIONS INTO CORRESPONDING MOTIONS OF A RECORDING APPARATUS (PEN,SCRIBE, ETC.). INCREMENTAL OR DIGITAL PLOTTERS MOVE IN STEPS OF A FIXED SIZE, WHILE ANALOG PLOTTERS MOVE IN STEPS CORRESPONDING TO A VOLTAGE LEVEL. Used with computers for graphic output.

PRINTER: A DEVICE THAT, IN A COMPUTER SYSTEM, PRINTS COMPUTER OUTPUT ON PAPER.

PROGRAM: A SERIES OF COMPUTER INSTRUCTIONS THAT CAUSE A SPECIFIC TASK OR GROUP OF TASKS TO BE PERFORMED.

REFRESH TUBE: A CRT, OF THE KIND USED IN TELEVISION RECEIVERS. The PICTURE ON THE SCREEN MUST BE SOMEHOW STORED AND "REPAINTED" AT LEAST #) TIMES PER SECOND, FOR "FLICKER-FREE" VIEWING. ONE ADVANTAGE OVER STORAGE TUBES: INDIVIDUAL LINES CAN BE ERASED.

SONIC DIGITIZER: A DIGITIZER THAT USES A SOUND SOURCE (USUALLY AN ELECTRIC SPARK GENERATOR) AND MICROPHONES TO DETERMINE THE CORRDINATES OF A LOCATION.

STORAGE TUBE: A CRT THE SCREEN OF WHICH IS COATED WITH SPEICAL BISTABLE PHOSPHORS. ONCE THE PHOSPHOR HAS BEEN "TURNED ON" BY A HIGH-VOLTAGE ELECTON BEAM, IT STAYS "ON" WITH A VERY LOW MAINTAINING VOLTAGE. The storage tube contains an electron 'gun' that'writes' on the screen in the usual way, and alos contains low- voltage "floodlights", which keep thephosphors that were "written on", "lit". In this manner, the picture is "stored" on the face ofthe tube. Storage tubes are used as low-cost, high-resolution and high-density graphic output devices for computers. Compare "refresh tube".

SOFTWARE: PROGRAMS AND DOCUMENTATION ASSOCIATED WITH A COMPUTER SYSTEM.

TELEPROCESSING: COMMUNICATIONS, USUALLY VIA TELEPHONE LINES, WITH A COMPUTER AT A DISTANT SITE.

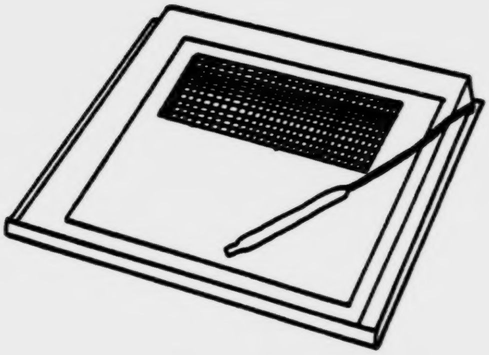
TERMINAL: A DEVICE FOR COMMUNICATED WITH A COMPUTER, E.G., A CRT SCREEN.

WORD: IN THE SENSE OF COMPUTERS, A "WORD" IS THE UNIT OF MEMORY WITHIN A PARTICULAR COMPUTER. SOME COMPUTERS HAVE 16-BIT WORDS, OTHERS HAVE 32-BIT WORDS, 60-BIT WORDS OR 12-BIT WORDS.

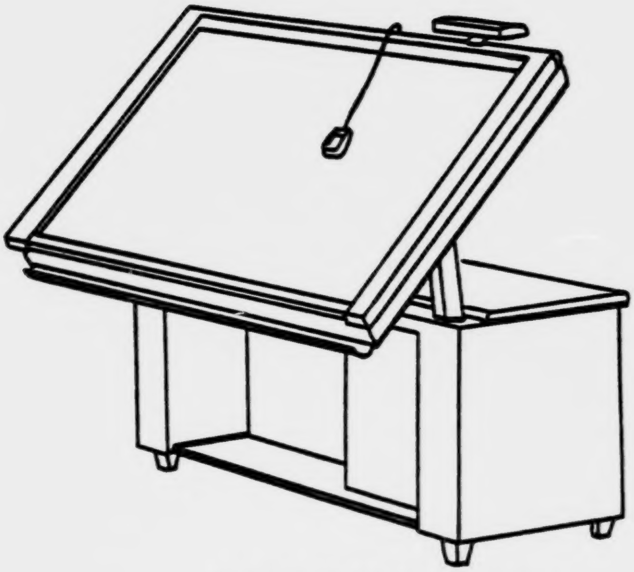
BASIC CONCEPTS
OF
COMPUTER AIDED DRAFTING

TRADITIONAL DRAFTING:	USING DRAFTING TOOLS, DRAW LINES, CURVES OR OTHER SHAPES BY PEOPLE DIRECTLY GENERATE IMAGE QUALITY OF DRAWING IS BASED ON THE SKILL AND TECHNIQUES STORED AS HARDCOPIES
COMPUTER AIDED DRAFTING:	USING COMPUET AND OTHER DIGITAL CONTROLLED DEVICES. DRAW LINES, CURVES OR OTHER SHAPES BY COMPUTER, AND ITS PERIPHERAL DEVICES. IMAGES WERE GENERATED BY THE COMPUTER COMMANDS, COORDINATES SYSTEM, MATHEMATICAL EQUATIONS Quality of drawing is standard Stored as digital data Standard symbols, parts can be retrieved at any time.

Computer-aided drafting input device.



Computer-aided drafting input device.



Computer-aided drafting input device.

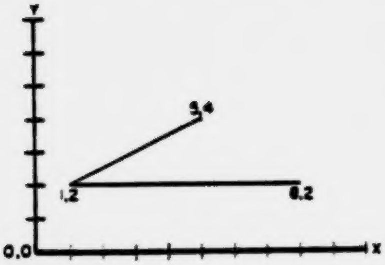
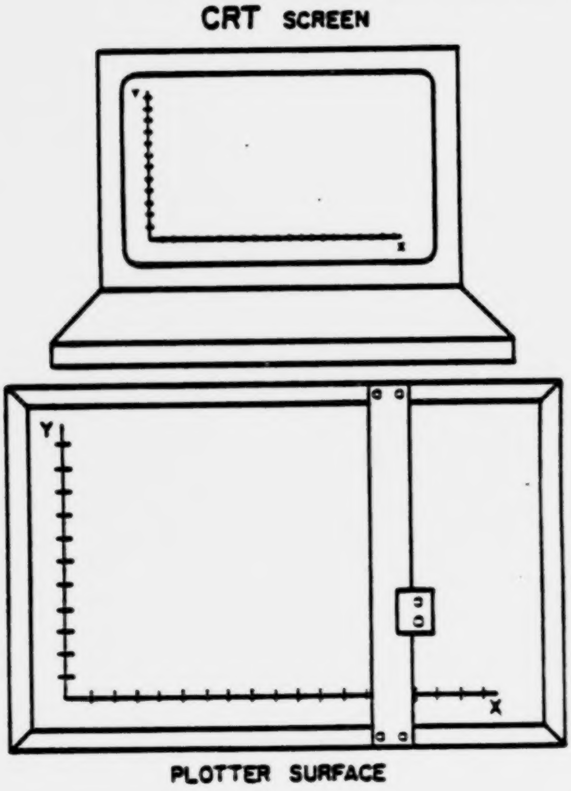
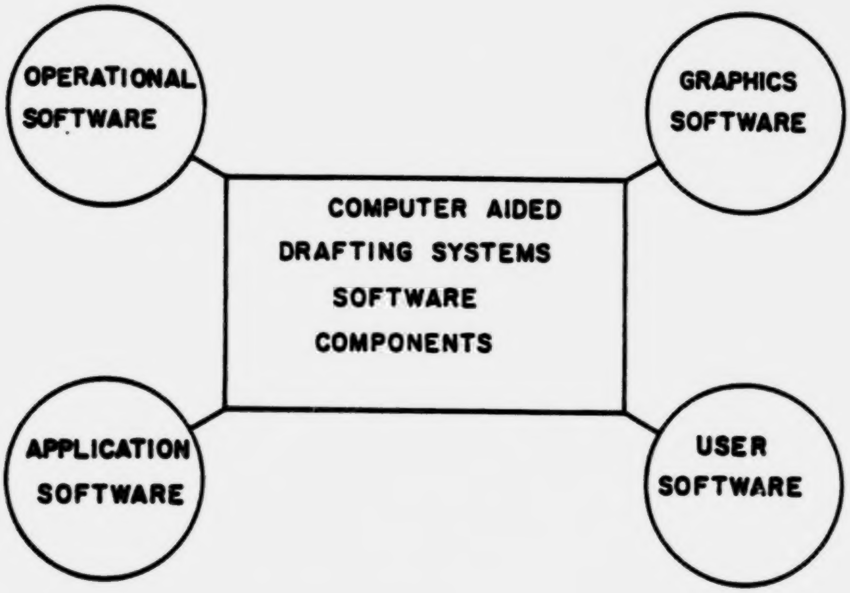


FIGURE 6-9 Plotting end points of a line.

Plotting on a Cartesian coordinate system.





Operational software makes possible the general operation of a computer-aided drafting system. This includes such tasks as memory allocation, scheduling of the processing unit, driving of input/output devices, arranging of priorities of operations, and interrupting of operations.

Graphics software is designed especially to allow the computer to deal with graphic data. This includes the ability to enter, manipulate, edit, revise, correct, and store two- and three-dimensional data such as points, lines, planes, arcs, and circles.

Applications software provides for the performance of drafting tasks within specific drafting fields, such as architectural, civil, electronics, mechanical, piping, and pictorial drafting. It also allows for specific tasks within each of these drafting fields, such as drawing engineering, layout, erection, or shop drawings.

User software is that which is developed by the computer-aided drafting system user at the workplace for applications that are specific to the user's company. User software is task oriented and frequently consists of such things as special-purpose computer-aided drafting templates known as *menus*, or special styles of lettering fonts. A menu is the electronic equivalent of a template. It resembles a large rectangular card which contains symbols or geometric shapes that are frequently used in a given drafting setting. By using the

SUMMARY AND REVIEW

- Interest in computer-aided drafting began to develop on a large scale in the early 1970s. By 1990, computer-aided drafting will probably be the norm even in smaller companies.
- The computer can be used not only in producing drawings, but also in compiling parts lists and bills of material, developing schedules, and in performing mathematical computations.
- Human beings' inherent slowness and inaccuracy in performing manual drafting tasks such as lettering, linework, and scalework, coupled with ever-increasing demands for higher levels of productivity, led to the wide-scale development of computer-aided drafting.
- Computer-aided drafting is not a new drafting field which has sprung up. Rather, it is a way of doing drafting which transcends all drafting fields.
- Drafting began to flourish as an occupation when industry converted to mass production methods.
- Computer-aided drafting is the latest in a long line of technological advances, such as drafting machines, templates, adjustable triangles, and reprographics, which have been designed to make the drafter more productive.
- The single most important benefit of computer-aided drafting is increased productivity.
- In most drafting applications, computer-aided drafting is from 5 to 20 times faster than manual techniques.
- In addition to producing drawings, computer-aided drafting systems can be used to perform engineering and design calculations, for cost estimation and material take-offs, for project scheduling, and for storage of drawings.
- Computer-aided drafting will not eliminate the need for drafters. Rather, it will allow drafters to do their jobs faster and better.
- The computer drafting technician needs the same basic drafting skills as the manual drafter as well as some new skills, such as a basic knowledge of computers, computer math skills, familiarity with a programming language, digitizing skills, and keyboard manipulation skills.
- Drafters do not normally develop the software for computer-aided drafting systems.
- Compared with manually prepared drawings, computer-produced drawings are superior in quality of lettering, scaling accuracy, and overall appearance.
- Computer-aided drafting can be done in all drafting fields. The most promising developments have been in the areas of architectural, civil, electronics, mechanical, piping, and pictorial drafting.

BASIC FUNCTIONS OF CADD SYSTEM

BASIC PLOTTING

LINE DRAWING

SHAPE DRAWING (ARC, CIRCLE, ELLIPSE, ETC.)

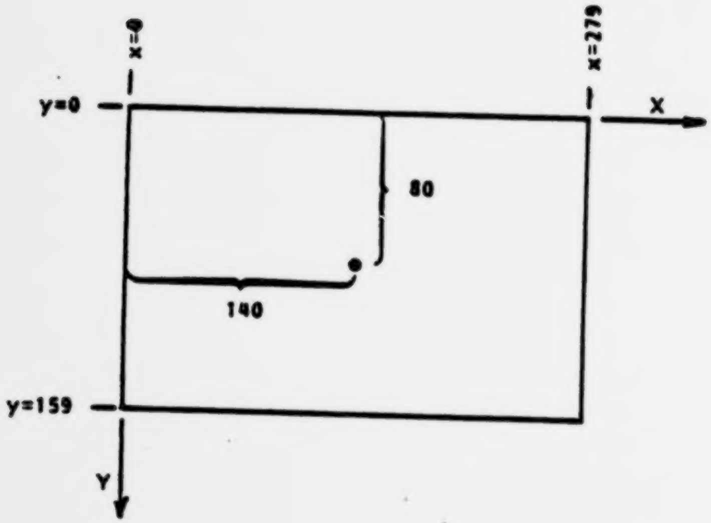
2D - INTERACTIVE GRAPHICS
2D - TRANSLATION
2D - SCALING AND STRETCHING
2D - CLIPPING
2D - ROTATION
3D - GRAPHICS
3D - TRANSLATION AND ROTATION

PERSPECTIVE

INTERSECTIONS

HIDDEN LINE REMOVAL

SHADING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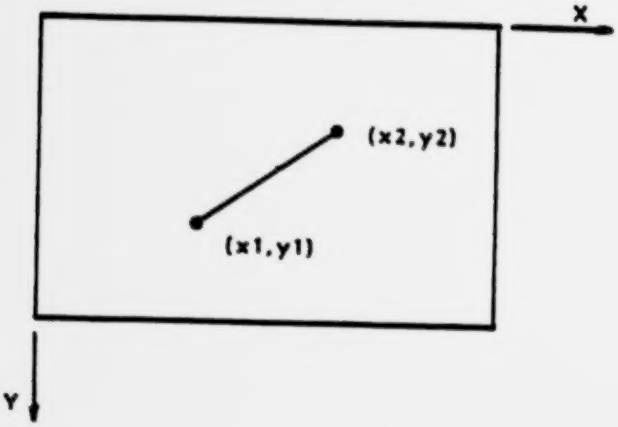
y=0
X
80
140
y=159
Y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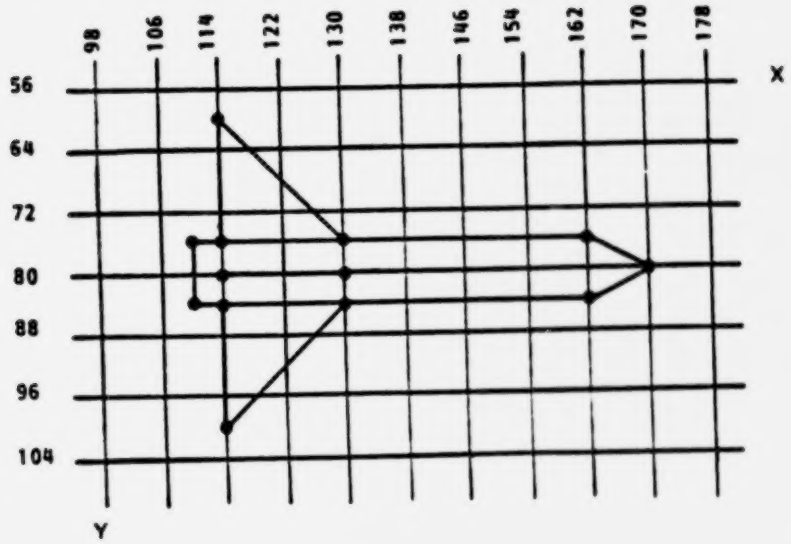
X
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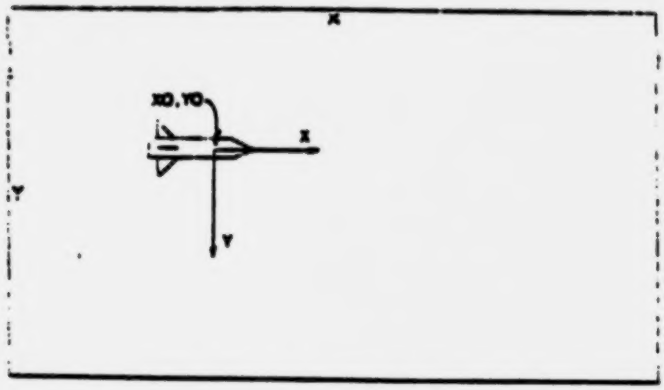
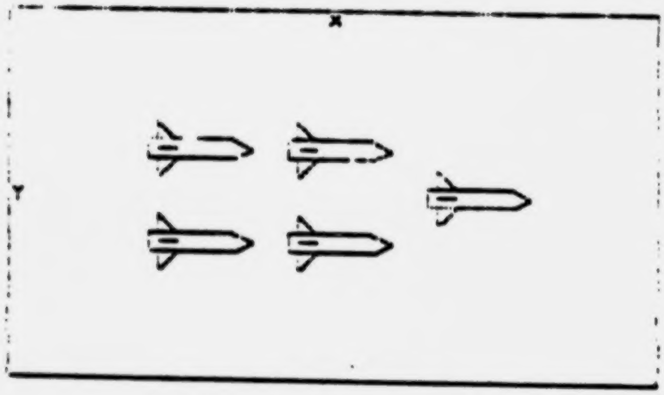

X
XO,YO
X
Y
Y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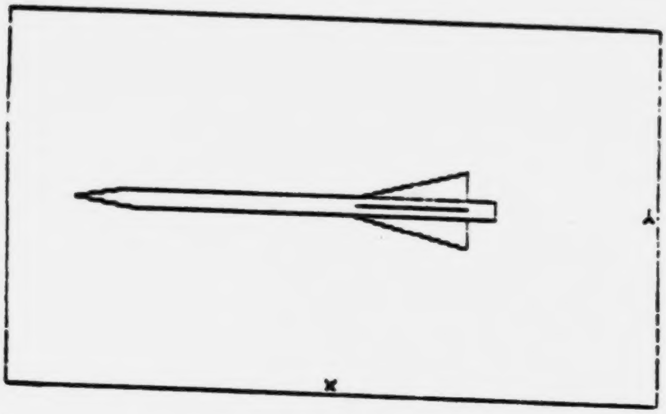

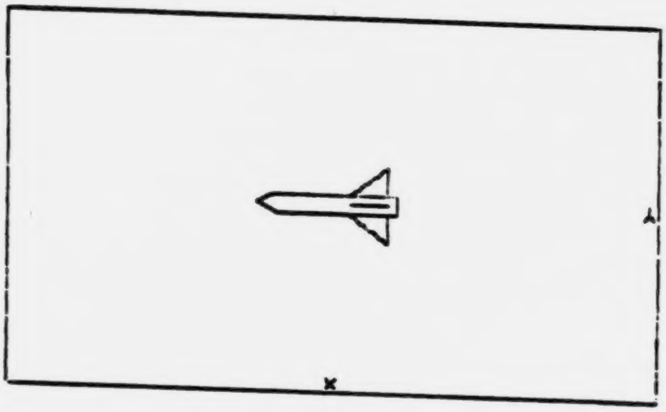

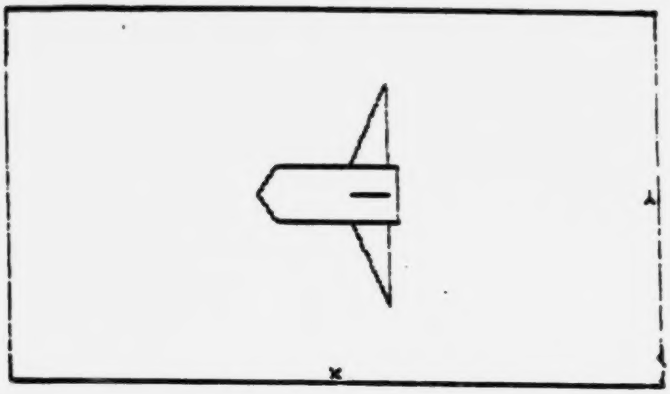
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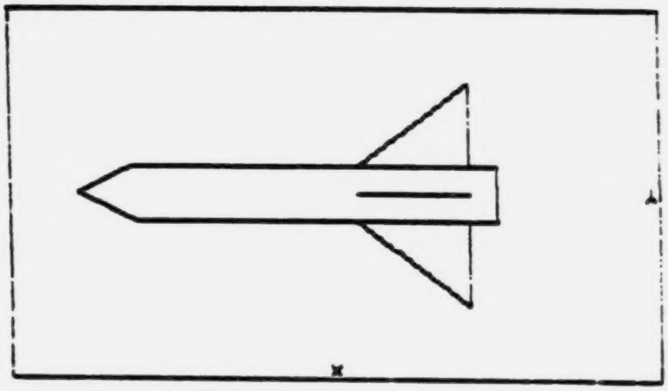
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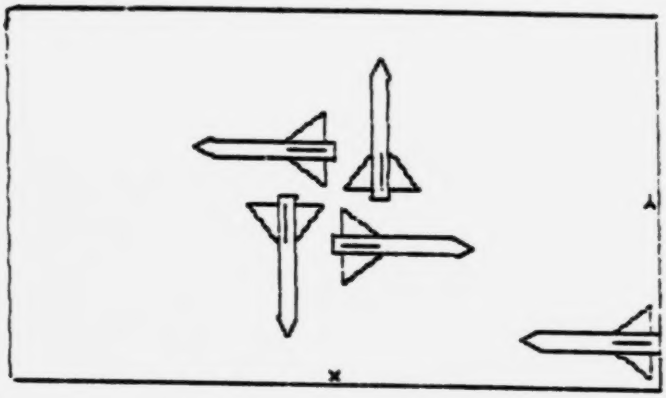

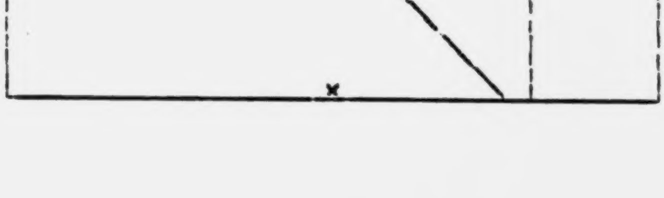

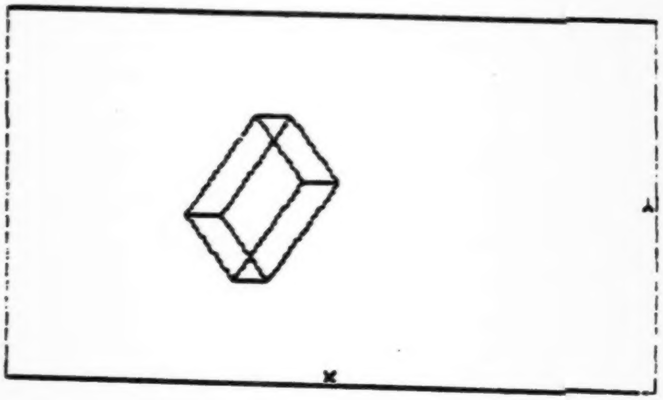
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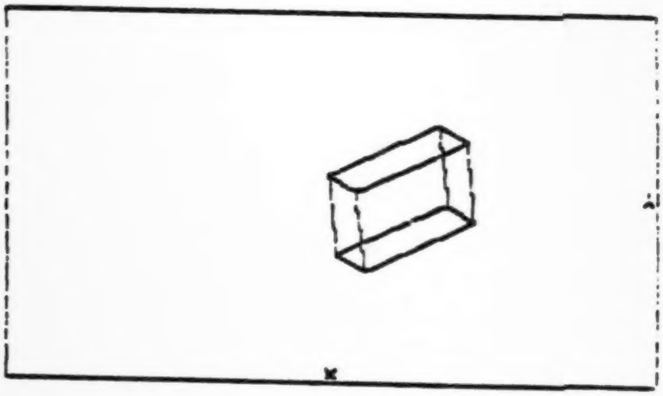
y
x

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DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 2

LAP TITLE: Coordinate Systems

PREREQUISITE LAP (S) : CADD 1

LAP PURPOSE: To understand basic 2-D, 3-D coordinates in both Cartesian and Polar systems.

COMPETENCIES TO BE DEVELOPED:

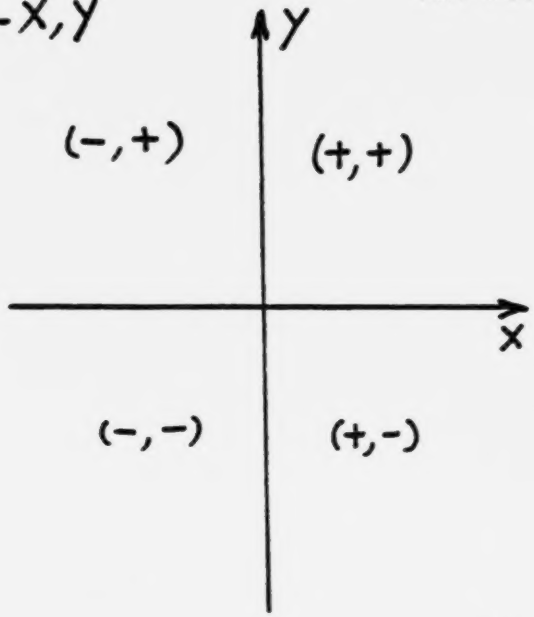
1. To identify the absolute coordinates of any point located in a 2-D plane with both Cartesian and Polar systems.
2. To identify the absolute coordinates of any point located in a 3-D space with the Cartesian system.
3. To indicate positive and negative rotating directions regarding all three axis.

COORDINATE SYSTEMS

1. CARTESIAN COORDINATES (RECTANGULAR)

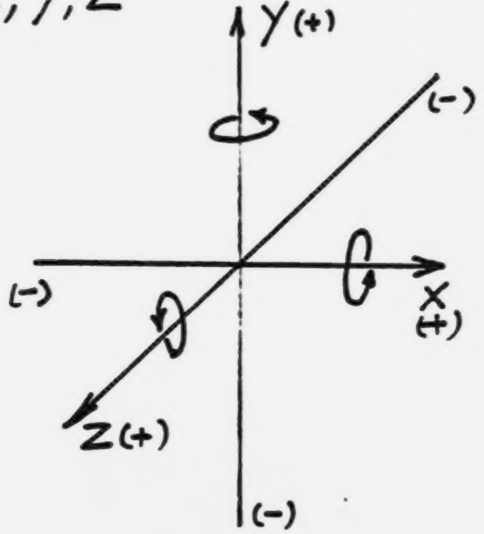
ANY POINTS: A(X,Y)

2D—X,Y



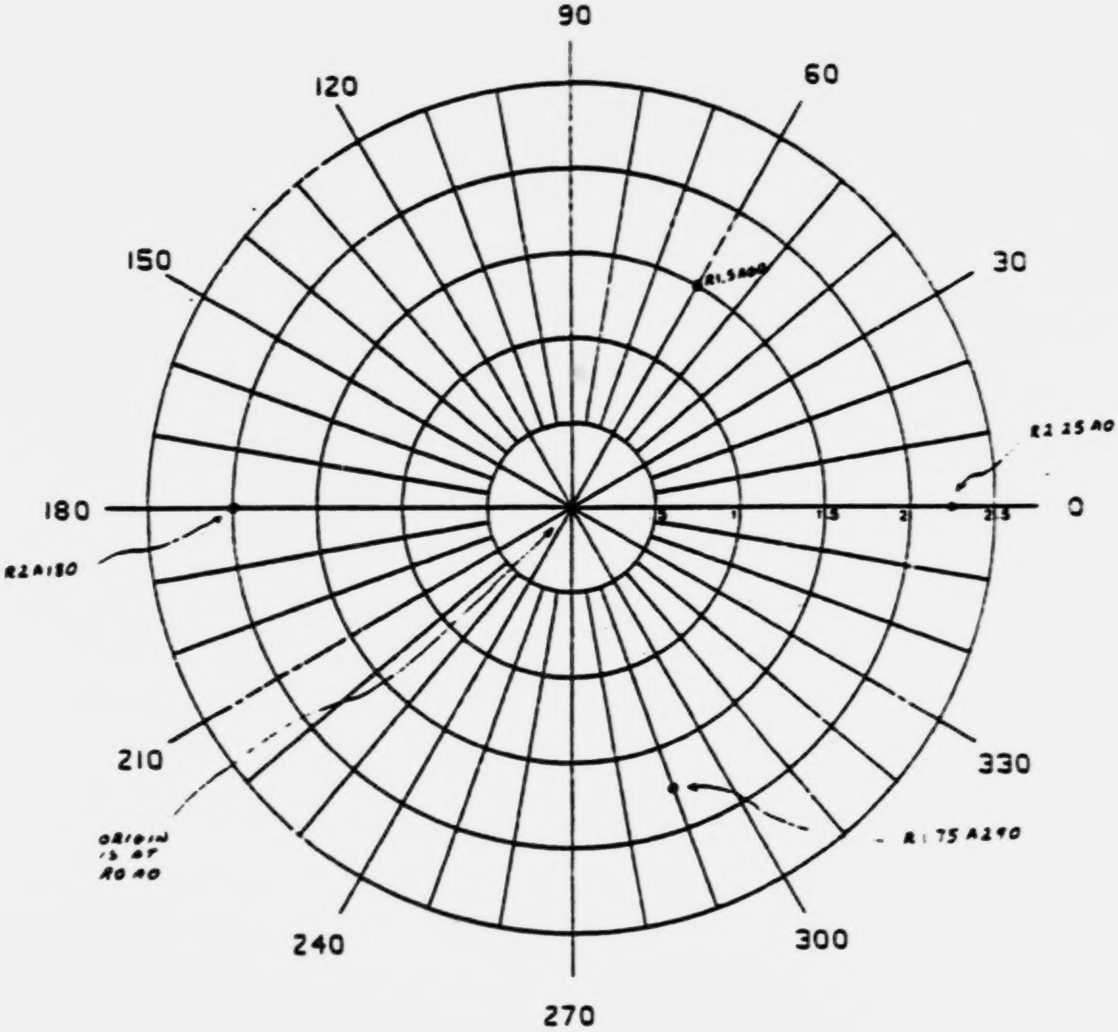
ANY POINT: A(X,Y,Z)

3D - X,Y,Z



X = The distance along the horizontal axis away from the origin.
Y = The distance along the vertical axis away from the origin.
Z = The distance along the toward you axis away from the origin.

2. POLAR COORDINATES



Any point A (R,A)

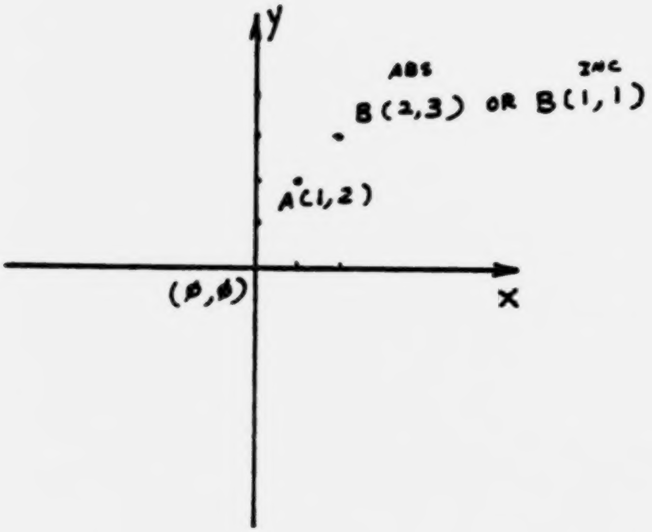
R = RADIUS, THE DISTANCE BETWEEN THE ORIGIN AND THE POINT

A = ANGLE, THE ANGLE MEASURE FROMTHE HORIZONTAL ASIX BY COUNTER CLOCKWISE ROTATION.

METHODS OF SPECIFING COORDINATES

1. ABSOLUTE COORDINATES - With absolute coordinates, data locations are defined in relation to their position from the origin.

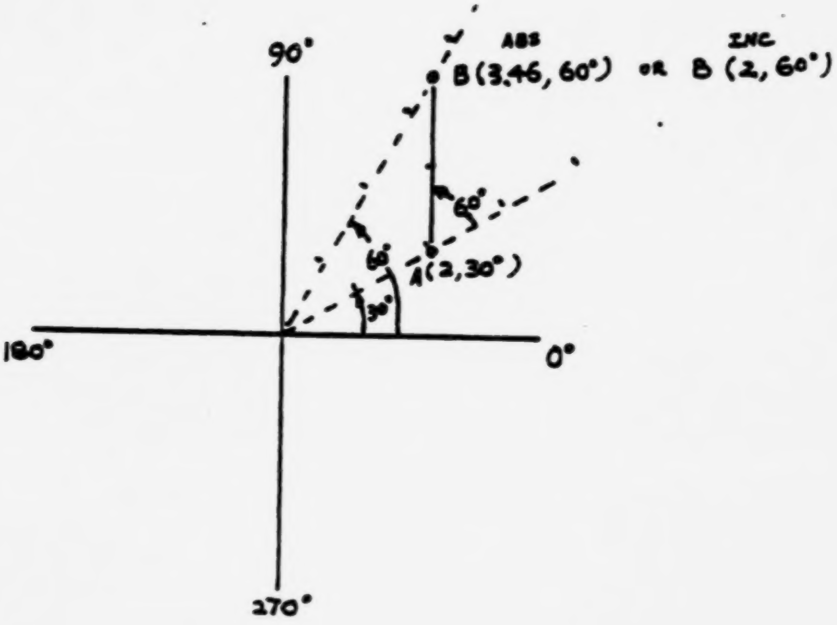
ABS: A(1,2), B(2,3)
INC: A(1,2), B(1,1)



METHODS OF SPECIFING COORDINATES

2. INCREMENTAL COORDINATES - Using incremental coordinates, data locations are defined in relation to the position of of the last entered location. (It is also called relative coordinates).

ABS: A(2,30°), B(3.46,60°)
INC: A(2,30°), B(2,60°)



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Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 3

LAP TITLE: Advanced Space Graphics Hardware Configuration and Basic Operations of the IBM PC Microcomputer

PREREQUISITE LAP (S) : CADD 1

LAP PURPOSE: To familiarize the total advanced space graphics hardware system and the basic features of the IBM PC.

COMPETENCIES TO BE DEVELOPED:

1. To identify and describe the Advanced Space Graphics hardware devices.
2. To perform the selected IBM keyboard entry commands.
3. To set-up the Epson dot matrix printer and to make it ready for operation.

Hardware Configuration

A. IBM PC - 192KB

Single Drive (a)	Single Side (1)	(The IBM PC we have is equipped with double side drive)

DOS 1.1
detached keyboard

B. Monitor - Color (320 x 176 pixels with 320 x 24 for text)

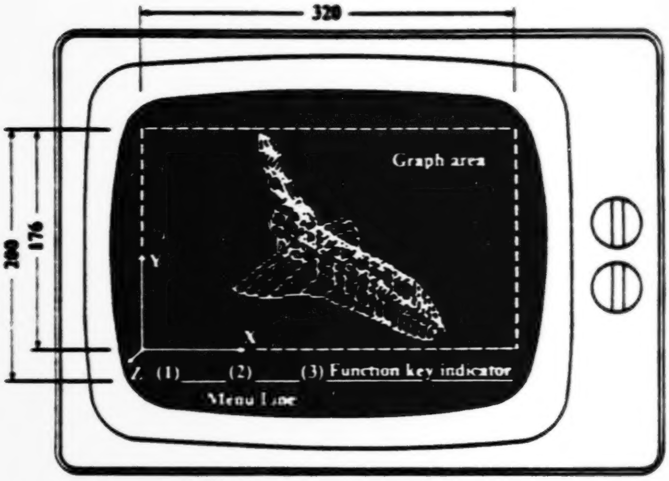
C. Space tablet (3D) (13.5" x 16" base, 14" reach)

D. MCS 2D tablet (2D)

E. Epson dot matrix printer

F. Houston Instrument HIPLOT (DMP-29) plotter

G. Interface cards and cables for interfacing
    color graphic
    RS 232 serial multiple ports
    parallel printer port
    game I/O

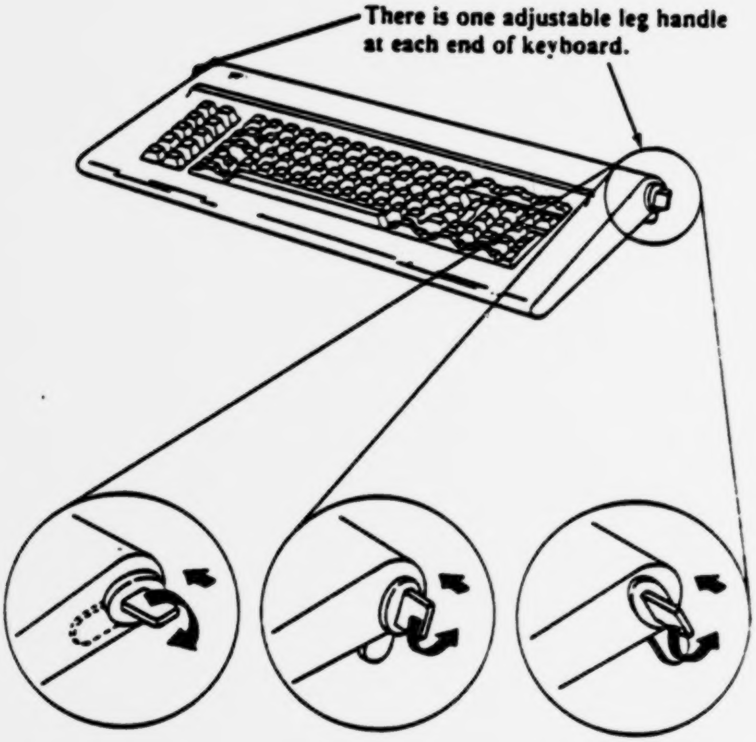


Layout of screen. X axis goes to the right, Y to the top, and Z comes out toward the viewer. The area in which graphs are drawn is 320 × 176 screen coordinate units.

Keyboard and Display Adjustment

The keyboard has adjustable tilt positions for typing comfort.

WARNING: Hold the keyboard when changing positions.



There is one adjustable leg handle at each end of keyboard.

Level Position
Firmly push in the adjustable leg handles and turn.

Tilt Position 1
Firmly push in the adjustable leg handles and turn.

Tilt Position 2
This position may not be available on your keyboard.

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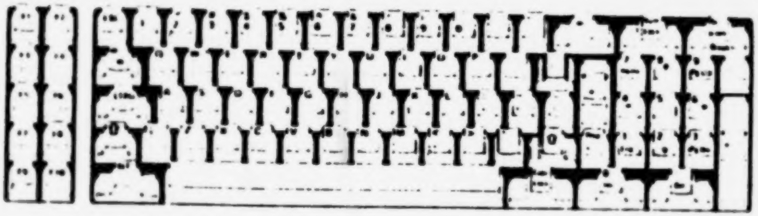
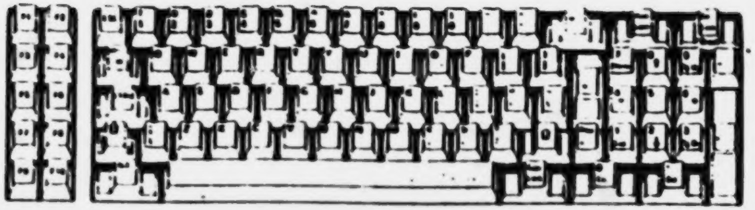
Keyboard



On the next few pages is a description of the IBM Personal Computer Keyboard. Take the time to read this information. Two points to remember:

- You cannot damage your IBM Personal Computer by pressing any key or combination of keys. You may not get the results you are looking for, but there is no way you can do any harm to any part of the computer, by pressing a key.
- Not all of the keys are used in every application. Different programs use different keys in different ways. Specific key usage is explained in the manual for whatever program you are using.



The unshaded keys are used to aid you in writing, updating, and running programs.

Key	Description
ESC	Escape: clears the line that has the cursor from the screen; does not delete that line if it is already in a program.
⇤ ⇥	TAB: performs a tab function similar to a typewriter. Tabs are set every 8 characters.
CTRL	Control: always used with another key to perform a command or function.
⇧	Shift: changes lowercase letters to uppercase.
ALT	Alternate: used with alpha typing keys to enter BASIC keywords
←	Backspace: moves the cursor to the left and removes one character for each keystroke.
↵	Enter: moves the cursor from the last character on one line to the first character of the next line. Shows the logical end of a line

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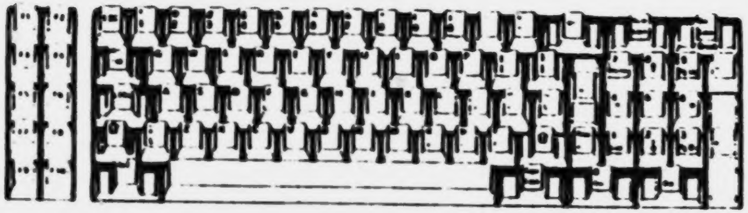

The unshaded keys are program function keys. They are used to make the system perform the commands listed below:

Key	Description
F1	LIST: displays the lines of your program on the screen.
F2	RUN: causes your program to begin execution from the beginning of the program.
F3	LOAD": reads your program from auxiliary storage (e.g., cassette) and stores it in main memory.
F4	SAVE": stores your program on auxiliary storage (e.g., cassette).
F5	CONT: restarts your program after you have interrupted it by a Stop or Ctrl Break.
F6	"LPT1:" refers to line printer and must be preceded by another command, e.g., LIST, "LPT1:" (list program to printer)
F7	TRON (trace on): causes the line numbers of the program lines to be displayed as the lines are executed.
F8	TROFF (trace off): cancels trace on
F9	KEY: used to change the function of other function keys
F10	SCREEN: returns the program to character mode

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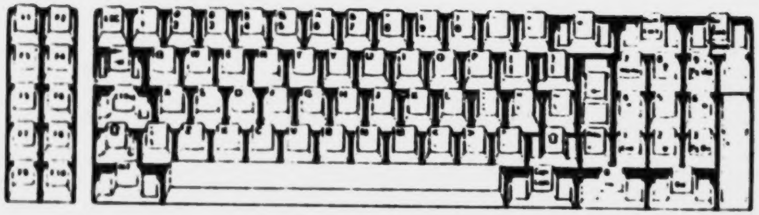
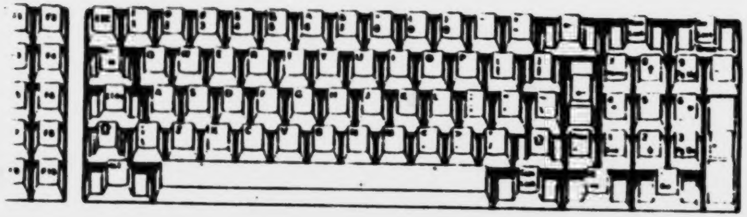


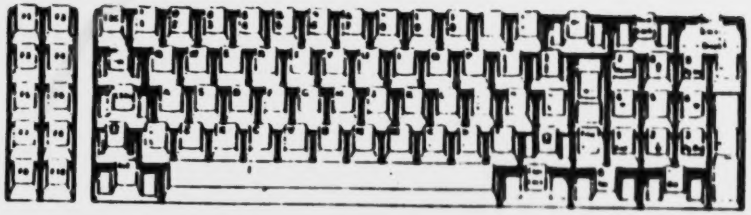
Num Lock means number lock, and is a toggle key; press once and the numeric keypad is activated. Press again and the numeric keypad is cancelled.

Key	Description
1 through 9	Num Lock activated 1 through 9 will be operative.
. Del	Decimal Point: used with the numeric keypad.
0 Ins	Zero: used with the numeric keypad.
	Minus: used with the numeric keypad.
+	Plus: used with the numeric keypad.



When Num Lock is pressed to cancel the numeric keypad, the following keys will be operative. The normal state of the Num Lock key is Off.

Key	Description
7 HOME	Home: moves the cursor to the first character of the top line of the screen.
8 ↑	Moves the cursor up one line each keystroke.
4 ←	Moves the cursor one character to the left each keystroke.
6 →	Moves the cursor one character to the right each keystroke.
2 ↓	Moves the cursor down one line for each keystroke.
1 END	End: Moves the cursor to the last character of the line.
DEL	Delete: deletes the character at the cursor's position.
0 INS	Insert: sets the keyboard to the insert mode. Typed characters will be entered at the cursor's position, and all data will move to the right. Press Insert key again to leave insert mode.



The unshaded keys will perform the following functions:

Key	Description
Caps Lock	This is a toggle key; pressing the key will cause letters to be in uppercase (capitals). Pressing the key again will return the letters to lowercase.
PrtSc *	Print Screen will print an asterisk (*). When pressed with the Shift key, it will print all data on the screen
Scroll Lock	An inactive key

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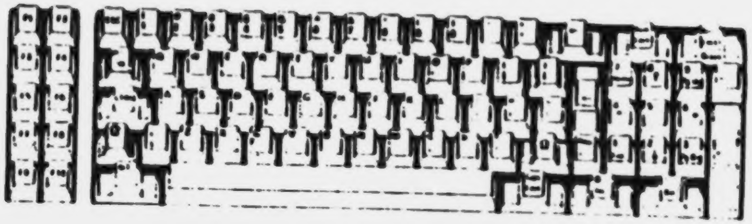


Below are examples of the Control and Alternate functions:

Ctrl + Scroll Lock = Break
This stops your program while it is running and identifies the line where the program stopped.

Ctrl + Num Lock = Pause
This stops your program. Press any key to continue.

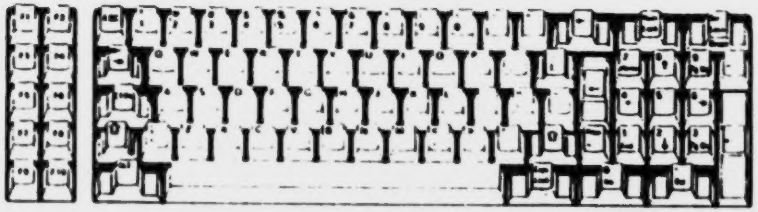
Ctrl + $\overset{6}{\rightarrow}$ = Next Word
Moves the cursor to the next word on the line.

Ctrl + $\overset{4}{\leftarrow}$ = Previous Word
Moves the cursor to the previous word on the line.

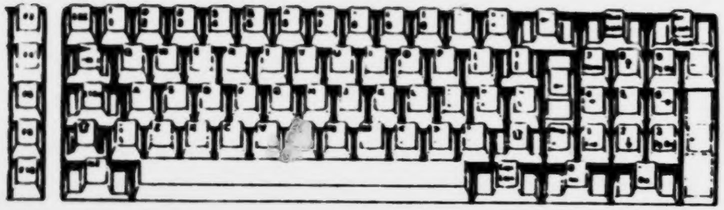
Ctrl + Home = Clear Screen
Removes all information on the screen and moves the cursor to the upper left corner.

Ctrl + Alt + Del = System Reset
Holding the Ctrl and the Alt keys, then pressing the Del key, reloads your system or program diskette. (An error will appear if you have a data diskette loaded.)

DOS Keyboard Usage



The unshaded keys are used the same as those on a normal typewriter.



Key	Description
F1	Redisplays previously-entered line, a character at a time.
F2	Press F2 and a character. The screen will redisplay all of the previously-entered line up to the character you entered.
F3	Redisplays entire previously-entered line.
F4	Press F4 and a character. This deletes all of the characters in the previously-entered line up to the character you entered.
F5	Stores the currently displayed line for further editing.

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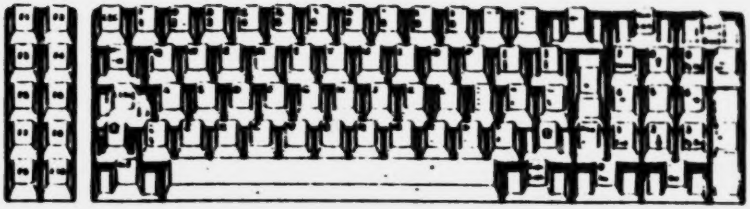


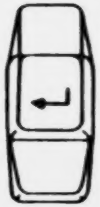
Below are examples of the Control functions.

Ctrl + Num Lock = Suspend
Suspends the operation of the system so you can read the screen. Press any key to continue.

Ctrl + PrtSc = Echo
Echoes and prints what you type and what the system displays until you press these keys again.

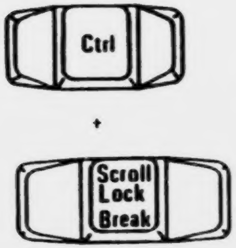
Ctrl + Scroll Lock Break = Break
This stops your command program while it is running.

To Enter a Command



Use the Enter key when you have finished typing a whole command. After you press the Enter key, the command starts (sometimes, you will see the word "executed" instead of "started").

To Stop a Command



Press and hold the Ctrl (Control) key, then press the Break key. Then release both keys to stop a command from finishing its job normally. (This is sometimes called "terminating" a program.)

DOS then shows you a prompt, and you can type your next command.

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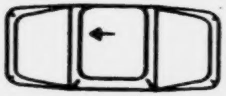
To Correct a Typing Mistake



There are several ways to correct a mistake that you notice before you press the Enter key. One of the easiest is to use the Backspace key to move the cursor backward, to the leftmost wrong character. The Backspace key deletes characters as it moves the cursor to the left. (The Backspace key is in the top row next to the Num Lock key.) Now type the correct characters, then press the Enter key when everything is the way you want it.

If the line is just too messed up to worry about, you can press the Esc (Escape) key. A Backslash (\) appears, and the cursor moves down one line on the screen. This cancels the messed-up line and you can then type the command correctly.

More ways to correct typing mistakes ("editing") are discussed in the *Disk Operating System* book, but these two keys should be enough to get you started.

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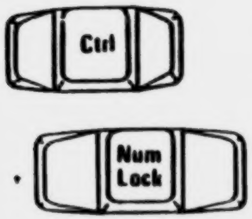
To Stop the Screen Long Enough to Read It



If information is appearing on the screen too fast for you to read, press and hold the Ctrl (Control) key and then press the Num Lock (Number Lock) key. Then release both of them. When you are ready to see more information, press any key.

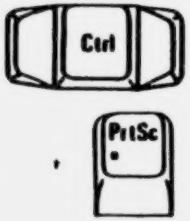
("Scrolling" is the term used to describe how a line of information moves up and off the top of the screen and new lines of information appear below it.)

To Print What Is on the Screen

If you have a printer and want to print what is currently on the screen, first make sure the printer is on. Then press and hold either Shift key, then press the PrtSc (Print screen) key, then release both keys.

What is printed is often called a "hard copy."

To Print Whatever You Type

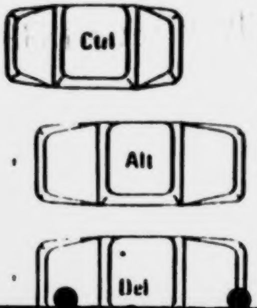


If you have a printer and want to print whatever you type and what the computer displays, press and hold the Ctrl (Control) key, then press the PrtSc (Print screen) key, then release them both. Now, each time you press the Enter key or the computer displays a line, the line will be printed ("echoed") at the printer.

To stop echoing to the printer, press the Ctrl and PrtSc keys again.

This is different from pressing the Shift and PrtSc keys. Shift and PrtSc print a whole screen's worth and nothing more. But Ctrl and PrtSc print one line at a time, line after line, until you press Ctrl and PrtSc again to stop the printing.

To Start DOS Again



If you want to restart DOS from the beginning, put your DOS diskette into drive A. Then press and hold down the Ctrl (Control) and Alt (Alternate) key, press the Del (Delete) key, then release all three. Remember, you may see this called System Reset.

After a while, you'll see the DOS startup message.

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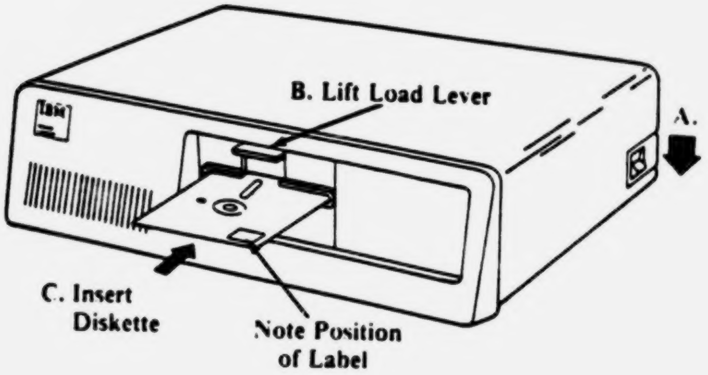
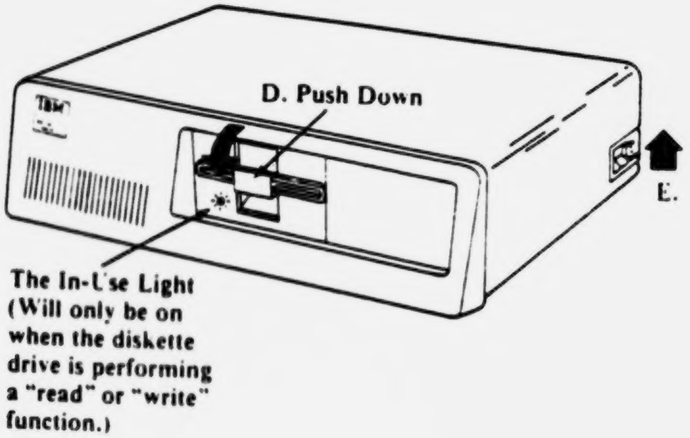
Loading Diskette

A. Set the system unit's Power switch to Off.
B. Lift the load lever.
C. Insert the diskette as shown until the rear stop is felt.
D. Push the load lever down and it will latch closed.
E. Set the system unit's Power switch to On.




D. Push Down
E.
The In-Use Light (Will only be on when the diskette drive is performing a "read" or "write" function.)

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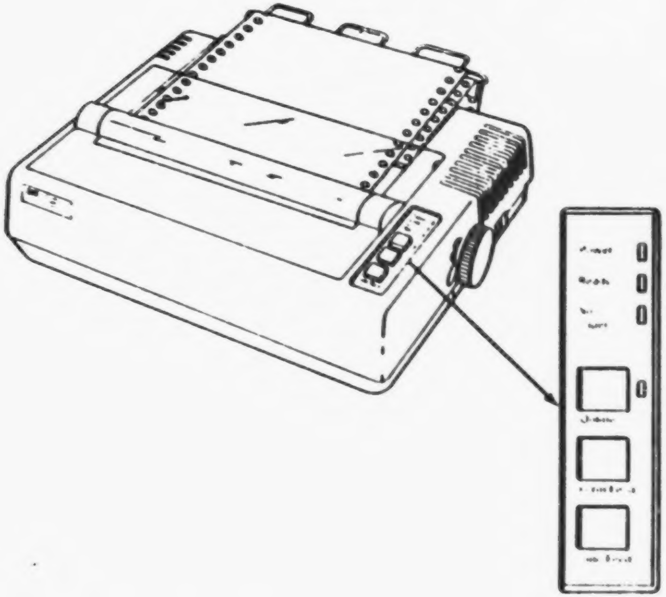
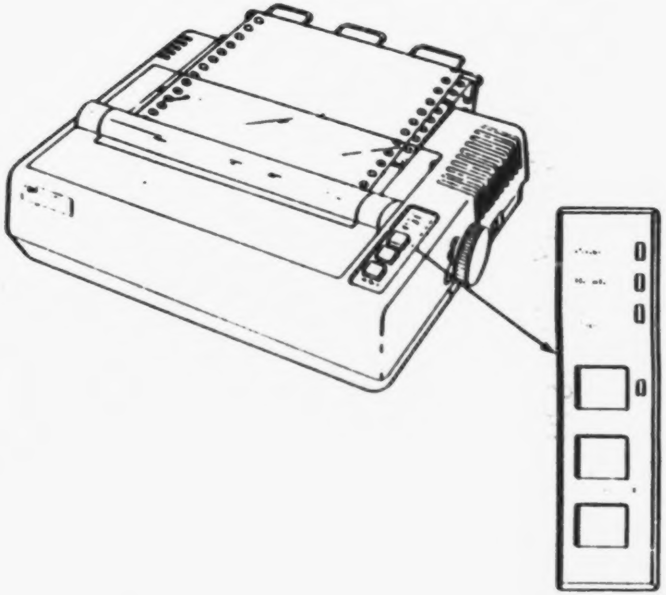
Printer Lights



1. **Power** light is on when the printer power is on.
2. **Ready** light is on when the printer is ready to receive information for printing. This light will turn on and off as the printer receives information from the computer.
3. **No Paper** light is on when the printer is out of paper or near the end. A beeping sound will also be heard from the printer.
4. **Online** light is on when the printer is prepared to receive information.

Printer Control Buttons



1. **Online** button changes the Online and Offline modes. The printer is in the Online mode when powered on. (Online light is on.) Pressing the Online button once places the printer in the Offline mode. (Online light is off.) Pressing the button once again places the printer back in the Online mode.
2. **Form Feed** button is pressed to advance the paper to the top of the next page. The printer must be in the Offline mode before the Form Feed button will work.
3. **Line Feed** button is pressed to advance the forms to the next line on the page. When the Line Feed button is held down, the paper will continue feeding until the button is released. The printer must be in

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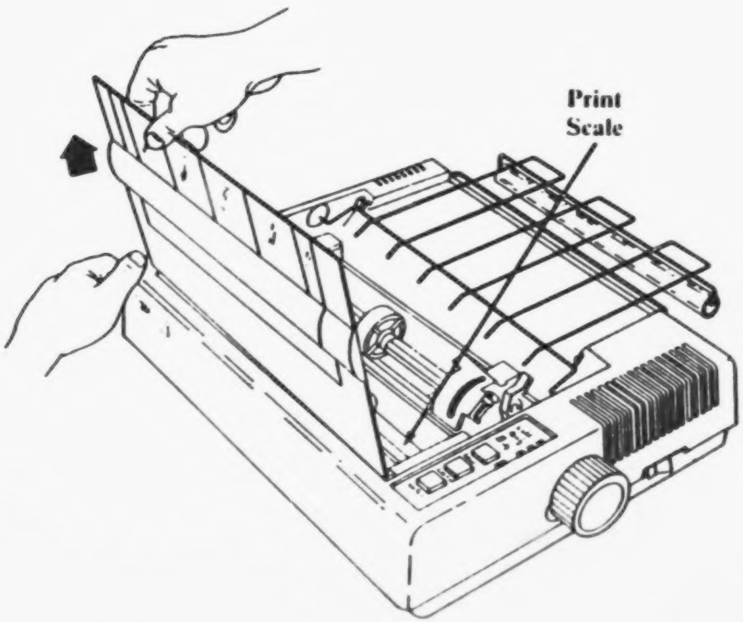
Ribbon Cartridge Installation

1. Set the printer Power switch to OFF.

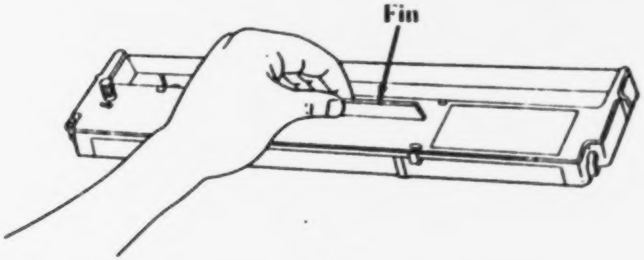
2. Raise the printer access cover and lift it from the printer base as shown.



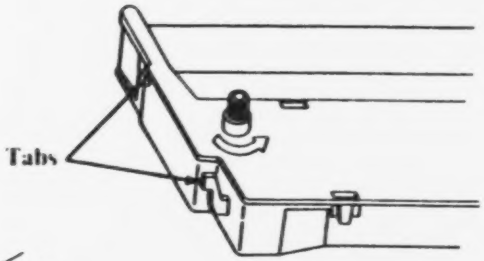
3. Check the print scale to be sure it is in the rear position.

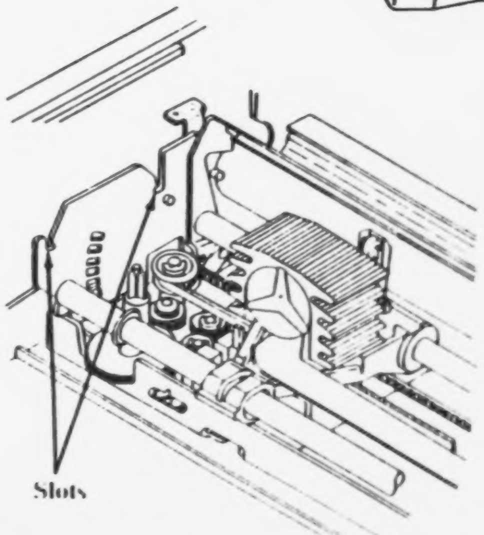
4. Remove the ribbon cartridge from the packing material.

5. Grasp the fin in the center of the ribbon cartridge.

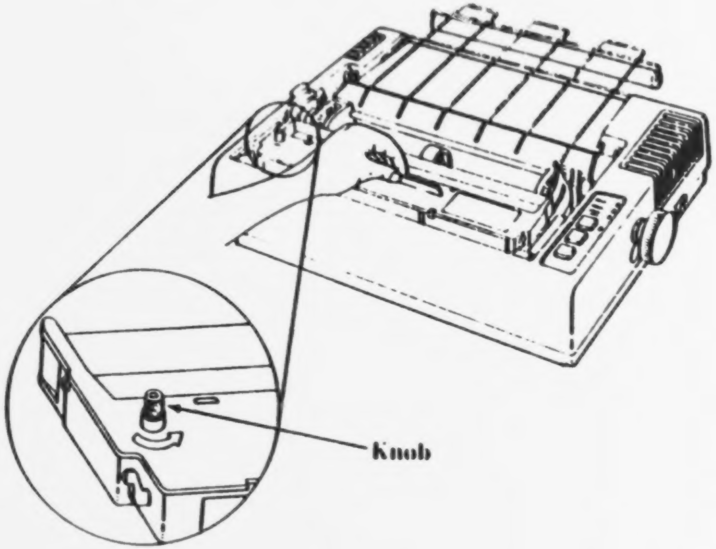


6. Guide the two tabs on the left side of the ribbon cartridge into the two slots on the left side of the printer frame.

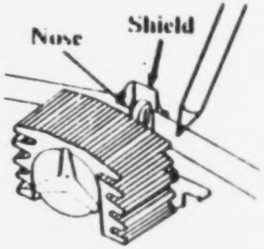




7. Guide the two tabs on the right side of the ribbon cartridge into the two slots on the right side of the printer frame. Press your ribbon cartridge firmly into place and turn the knob in the direction of the arrow to remove any slack in the ribbon.



8. Using a pencil or your finger, guide the ribbon into the slot between the nose of the print head and the ribbon shield.



9. Carefully move the print head to be sure the ribbon is free to move between the nose of the print head and the ribbon shield.

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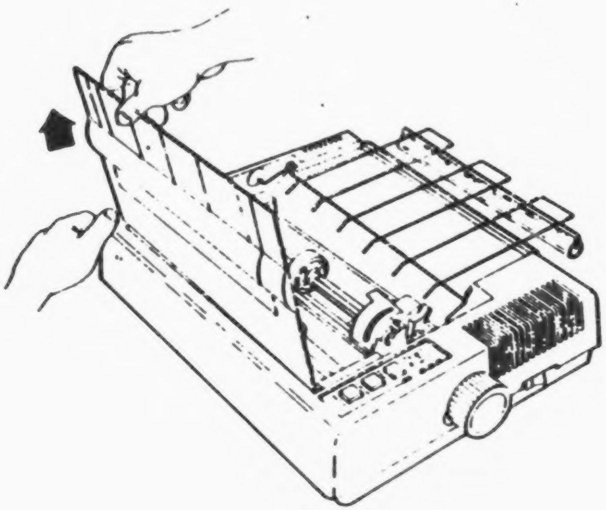
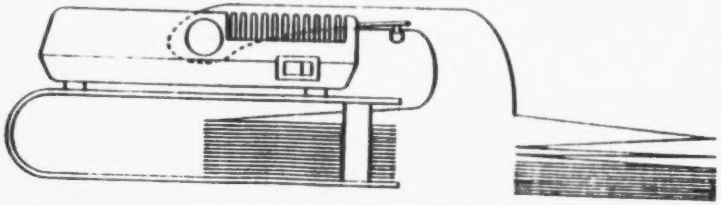
Forms Installation

1. Set the printer Power switch to OFF.

2. Raise the printer access cover and lift it from the printer base as shown.

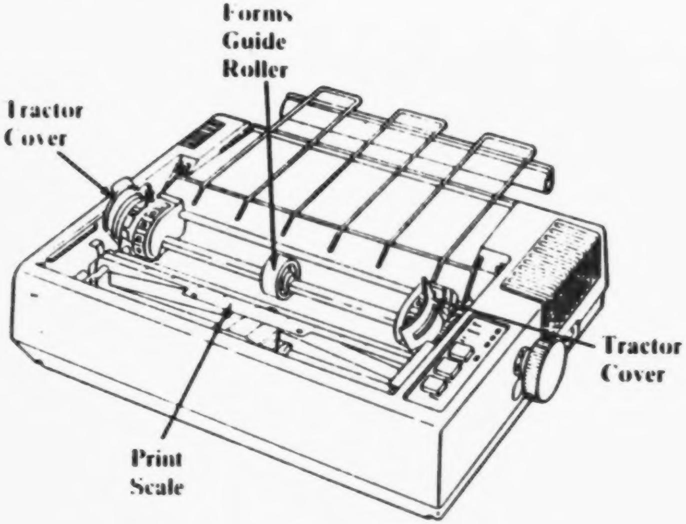


3. Position the forms behind and below the printer. If you have a printer stand, that's ideal. The floor will also work well. See the example below.

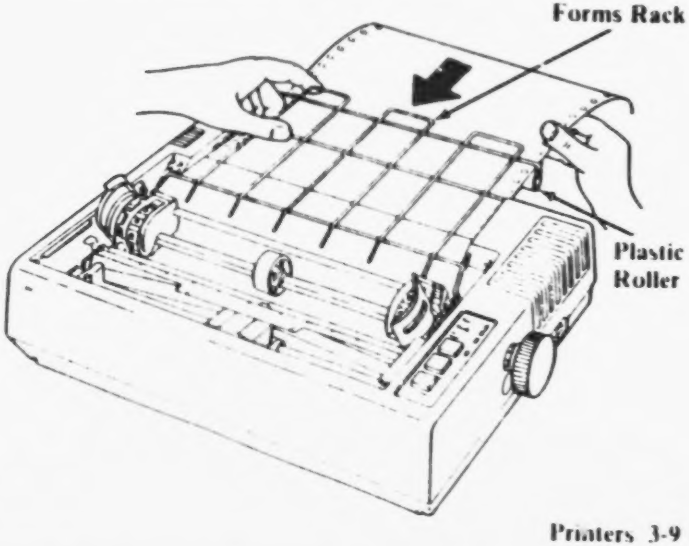


4. Move the print scale towards you, and center the forms guide roller.

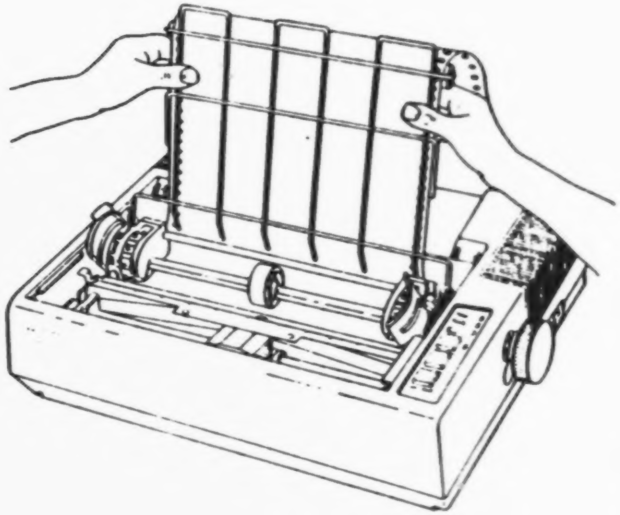
5. Open the tractor covers.



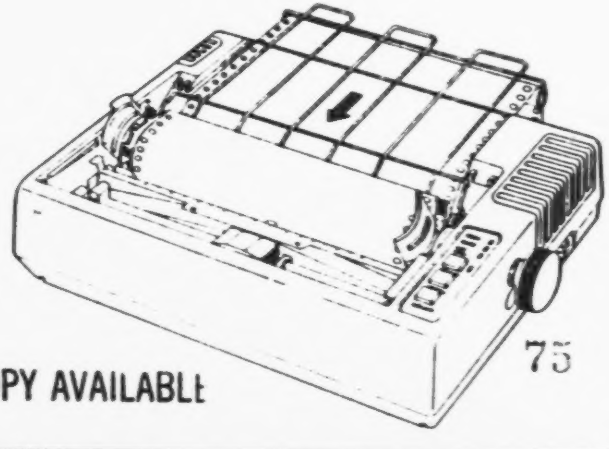
6. Insert the end of the forms into the opening between the forms rack and plastic roller.



7. Tilt the forms rack up, as shown, when you guide the forms into the printer opening.



8. Push the forms into the opening until 3 or 4 inches appear in the front.



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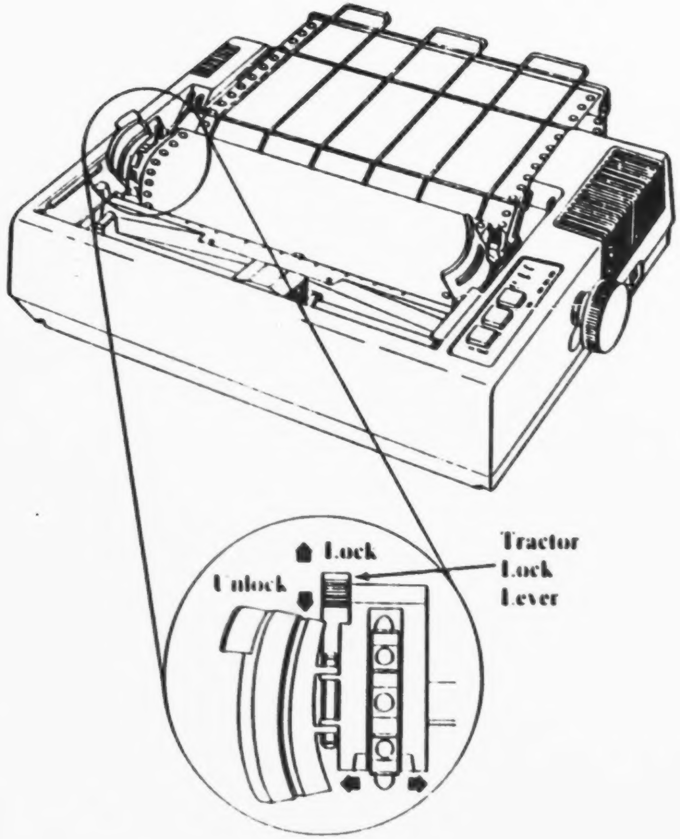
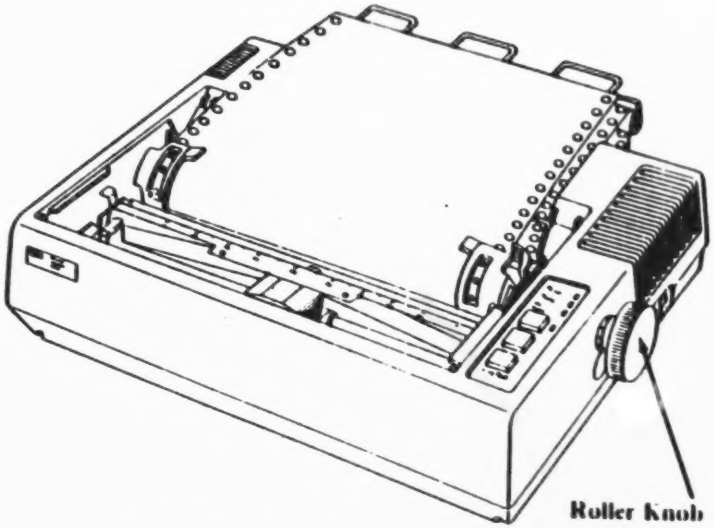
9. If the forms width is different from the distance between the tractors, unlock the tractors by tilting the tractor lock levers forward and slide the tractors over.



10. Position the forms holes on top of the tractor pins and close the tractor covers. Adjust the tractors so the forms are centered and to remove any buckle in the forms.

11. Lock [illegible] tractors in [illegible] by tilting the [illegible] lock



WARNING: Always roll the forms ahead. Rolling the forms backwards may damage your printer.

12. Roll the forms up with the Roller knob. Look to see that the forms are feeding properly. (Be sure that the forms are centered under or behind the printer. Do not allow the forms to rub against anything, including the printer cable.)

13. Move the print scale to the rear so that it is against the forms.

14. Replace the access cover by reversing the instructions in Step 2.

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UNIVERSITY OF
NORTH DAKOTA
DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 4

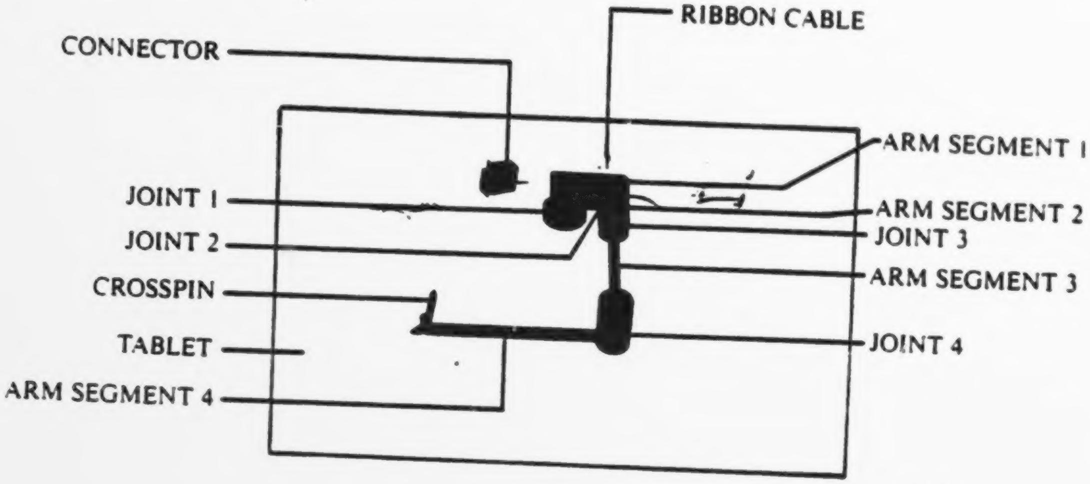
LAP TITLE: Advanced Space Graphics system set-up and Space Tablet Calibration

PREREQUISITE LAP (S) : CADD 3

LAP PURPOSE: To set-up the Advanced Space Graphics systems and to calibrate the Space Tablet.

COMPETENCIES TO BE DEVELOPED:

1. To set-up the Advanced Space Graphics system which consists of IBM PC, color monitor, Epson printer, Houston plotter, 3-D Space Tablet and MCS 2-D tablet.
2. To set-up the configuration parameters.
3. To calibrate the 3-D space tablet.



The SPACE TABLET

EXAMINING THE SET-UP

A. Power Connections
   1. IBM PC
   2. Monitor
   3. Printer
   4. Plottor
   5. MCS 2-D tablet with power supply

B. Interfaces/connections
   1. Keyboard to IBM PC (Keyboard)
   2. Monitor to IBM PC (RGB cord)
   3. Printer to IBM PC (Printer parallel)
   4. Plotter to IBm PC (COM 1 serial)
   5. Space tablet (3D) to IBM PC (Game I/O)
   6. MCS 2-D tablet to IBM PC (COM 2 serial)

C. Configuration Set (run utility disk)

You don't need to do this step as long as the hardware systems not changed.

If you do wish to try this step, see Owner's Manual P.12-1 to P. 12-5.

*Brief Procedure:

1. With the utilities disk operating at DOS level
2. A > CONFIGUR
3. go through all configuration parameters (either stay with the default or enter desired parameter)

Parameter	Default
(i) program disk drive	disk drive A
(ii) plotter port	COM 1
(iii) 2-D digitizer port	COM 2
(iv) 3-D digitizer card	GAME I/O
(v) Counts in space tablet average	2

4. The configuration parameters, then will be stored in the disk under CONFIG. DAT. (writer protect off)
5. Copy the CONFIG.DAT. onto INGRAPH and OUTGRAPH (writer protect off) (To copy a file with only one disk drive, see p. 76 for procedures.)

D. Space tablet (3-D) Calibration: (See Owner's Manual p. 12-7 to p. 12-24)

There are 29 positions needed to be calibrated.

There are two sides of the calibration sheet:

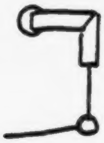
side #1	Positions 1 - 9
side #2	Positions 10 - 17

There is a triangular block for angles:

Positions 18 - 29

Brief Procedures:

1. Peel off the writer protect tape from the INGRAPH disk, if there is one.
2. With the INGRAPH disk operation at system level
   INPUT ----> TAB-3D ----> (insert the utilities disk)CALIBR
3. Remove the crosspin and be sure the tablet arm's in the initial position insert the INGRAPH DISK.



4. Go through all 29 positions (see illustrations and descriptions on following pages.)
5. Once the calibration is completed the calibration data will be stored under CALIBR.DAT. automatically (Make sure the new CALIBR. - DAT. must be in the INGRAPH disk)

CALIBRATION

The calibration program (CALIBR.EXE) calibrates the SPACE TABLET™ so that accurate results will be obtained. The program is run from the DOS level of the UTILITIES disk by typing CALIBR, or from the 3-D TABLET menu of the INGRAPH disk.

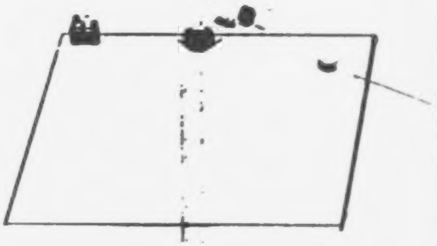
Once the SPACE TABLET™ is set up, it needs to be calibrated so that accurate results will be obtained. Calibration is critical for the accurate functioning of the SPACE TABLET™. A poor calibration will lead to poor data. Calibration entails orienting the tablet arm in 29 positions and entering data at each position. This may seem like an elaborate and tedious process, but after a few calibrations it will become second nature. The directions are straightforward and are supported by diagrams on the following pages. When in doubt, follow the directions verbatim and consult the appropriate diagram. The joints and arm segments of the tablet's arm will be referred to by their proper labels as shown on page 3-2. You should become familiar with these labels before starting calibration.

NOTE: The SPACE TABLET™ shown in the calibration photos may not be the model you own. Don't worry, the procedure is identical for both models.

The calibration procedure is as follows:

> Remove the crosspin and be sure that the tablet arm is in the initial position. There are two different ways to orient the arm and still place the base of joint 4 on the tablet surface tangent to any of the lines on the calibration sheet (as is done in positions 1-7). Only one of these orientations (the initial position) will yield accurate results. With joint 4 in the center of the tablet, the initial position is achieved when joint 2 is to the right of joint 1. The first 21 positions will consist of deviations originating from this position.
>
> **Position 1:** Place the calibration sheet on the tablet surface (under the arm) so that the "V" cutout is flush against the base of joint 1 and side #1 of the calibration

Position 1



Position 2

Position 3

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sheet is facing up. The top edge of the calibration sheet should be approximately parallel to the top edge of the tablet, and each of the 7 black lines on the calibration sheet should lie on the tablet surface. Place the base of joint 4 flat on the tablet surface, TANGENT TO line 1. Joint 4 should be above line 1 and should cover the encircled number 1 on the calibration sheet. If you started from the initial position (as you should have), joint 2 should extend beyond the upper edge of the tablet. The position of the pointer is not important.

Press the SPACE BAR on the IBM PC keyboard.

KEEP THE CALIBRATION SHEET STATIONARY DURING POSITIONS 1-7! Movement of the sheet during positions 1-7 will yield innaccurate results. Steps 1-7 calibrate the precision potentiometer located within joint 1. The other positions calibrate the three remaining potentiometers in a similar fashion. The potentiometer being calibrated and its angle at each position are given on the computer screen.

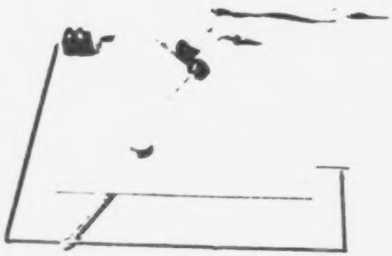
NOTE: The base of joint 4 may be slightly rounded. If this is the case, insure that the joint lies tangent to the line by looking down on the joint or by placing the triangular block along the line and moving the joint until it just touches the side of the block.

Position 2: Keeping the calibration sheet stationary, move joint 4 so that it is tangent to line 2, and the base of joint 4 covers the encircled number 2 on the sheet. The pointer's position is not critical, though for best accuracy, minimize the pointer's movement throughout positions 1-7.

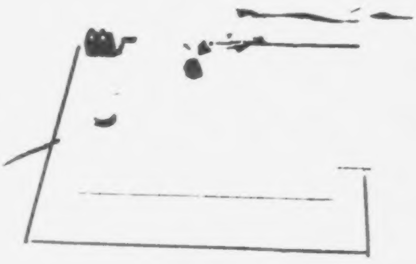
Press the SPACE BAR.

Positions 3-7: Do the same for positions 3 through 7 as you did for positions 1 and 2: Continue moving the arm so that the base of joint 4 lies flat on the surface, tangent to lines 3-7, and covering the encircled numbers 3 through 7 respectively. Enter data after each position by pressing the SPACE BAR on the IBM PC

Position 4



Position 5



Position 6

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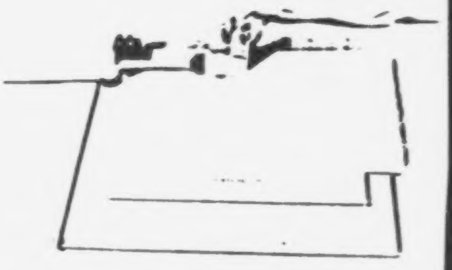
keyboard. Remember not to move the calibration sheet between any of these positions as such movement will invalidate your calibration.

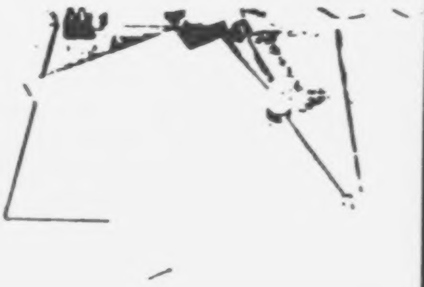
When position 7 has been completed, the computer will ask you if you wish to recalibrate the potentiometer (in this case potentiometer 1). If you answer NO (by pressing function key 1) the calibration procedure will continue with position 8. If you answer YES (by pressing function key 2), you will start again with position 1.

The same thing will occur when the final positions in the calibration of the second, third, and fourth potentiometer are completed and at the end of positions 8, 28, and 29. Hence if you make a mistake in the calibration of a potentiometer, you can recalibrate it without having to begin the entire calibration procedure over.



Position 7

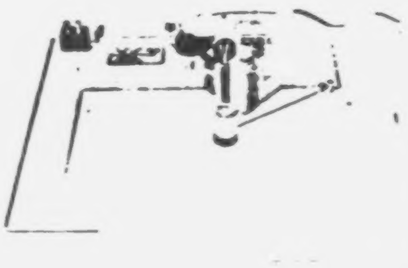
Position 8: Move the calibration sheet so that its square cutout (located in the lower right hand corner of side #1) lies flush against the base of joint 1, with side #1 facing up. The calibration sheet should touch the base of joint 1 at two points. Now align the short diagonal cut on the lower left hand corner of side #1 so that it just touches the right edge of the tablet. Move the tablet arm so that joint 4 lies tangent to the line beneath the words "CALIBRATION SHEET" and so the base of joint 4 covers the encircled number 8 on the sheet. The tip of the tablet's pointer should lie ON the line of tangency.



Position 8

Press the SPACE BAR.

Position 9: Flip the calibration sheet over so that side #2 is facing up. Move the sheet so that the base of joint 4 lies precisely within the circle in the center of the sheet. Try to get as many of the 9 black lines of the calibration sheet on the tablet surface as possible (the bottoms of lines 12, 13, and 14 will invariably hang over the bottom edge of the tablet). Move the pointer so that its tip lies precisely on line number 9.



Position 9

8·1

Press the SPACE BAR.

KEEP THE CALIBRATION SHEET STATIONARY DURING POSITIONS 9-17!

Position 10: Keeping the calibration sheet stationary and joint 4 centered in the circle, move the pointer tip so that it lies precisely on line number 10.

Press the SPACE BAR.

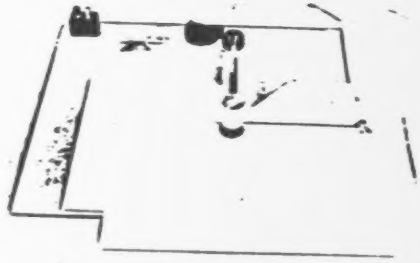
Positions 11-17: Do the same for positions 11 through 17 as you did for positions 9 and 10. Continue positioning the pointer tip (keeping the calibration sheet stationary and joint 4 centered within the circle) so that it lies precisely on lines 11, 12, 13, 14, 15, 16, and 17. After each position, enter data by pressing the SPACE BAR on the IBM PC keyboard.

Positions 18 through 29 do not require the use of the calibration sheet. Instead, the triangular block is used. The descriptions of these positions are best understood when supplemented with the diagrams. Consult them whenever a description seems confusing.

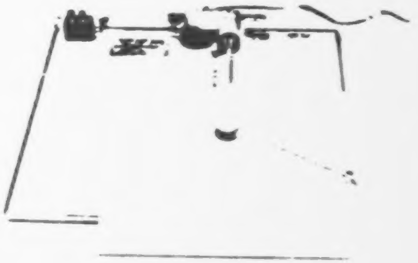
Position 18: Remove the calibration sheet. Move the arm so that joint 4 lies in the upper left hand corner of the tablet. Be sure that the base of joint 4 lies flat on the tablet surface. Neither the specific position of joint 4 nor that of the pointer is critical.

Press the SPACE BAR.

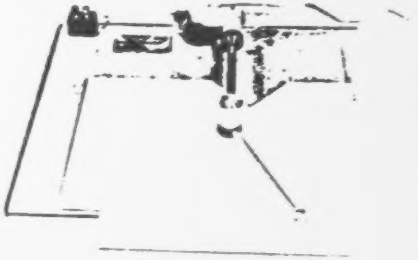
Position 19: Rotate joint 2 out of the plane of the tablet by lifting joint 4. Stand the triangular block up on one side and place it under arm segment 2 such that arm segment 2 lies flat against the HYPOTENUSE of the triangular block (the hypotenuse is the side opposite the 90 degree angle). When done correctly, joint 4 should be on the LEFT side of the tablet and elevated at a 45 degree angle. Be sure that the edge on which the triangle is standing is flat on the tablet surface.



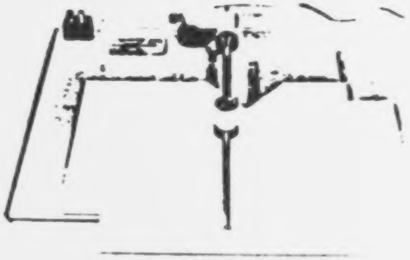
Position 10



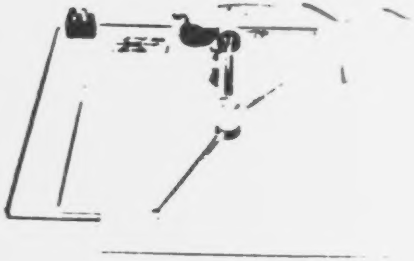
Position 11



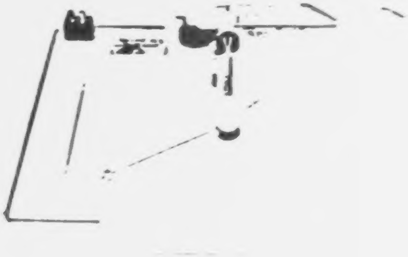
Position 12



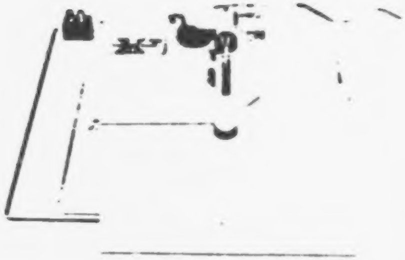
Position 13



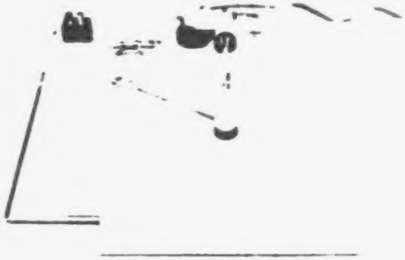
Position 14



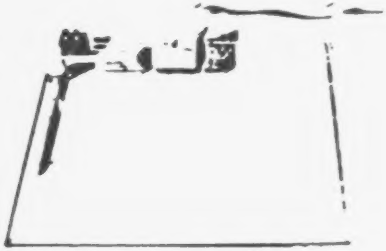
Position 15



Position 16



Position 17



Position 18

Press the SPACE BAR.

Position 20: Rotate joint 2 up further (by lifting joint 4) until arm segment 2 is pointing directly up into the air. Now place the triangular block next to arm segment 2. Be sure that arm segment 2 lies flush against one edge of the block, and that the other edge of the block lies flush against the tablet surface. When done properly, joint 4 should be pointing straight up at a 90 degree angle and the hypotenuse of the triangle should be touching neither the arm nor the tablet.

Press the SPACE BAR.

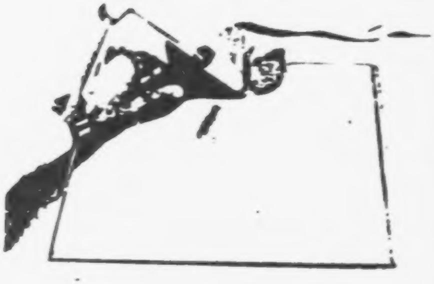
Position 21: Rotate joint 2 further until arm segment 3 points approximately 45 degrees up and to the RIGHT. Place the triangle under the arm such that arm segment 2 lies flush against the hypotenuse, and the base of the triangle lies flat on the tablet surface. This is the same as position 19, though with joint 4 on the right rather than on the left.

Press the SPACE BAR.

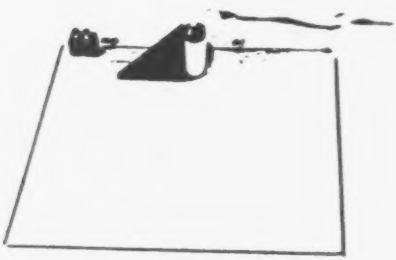
Position 22: Remove the triangular block and rotate joint 2 down so that joint 4 lies flat on the right side of the tablet surface. Be sure to rotate joint 3 so that the base of joint 4 lies flat on the tablet surface. Notice that the arm is no longer in the initial position (if you bring joint 4 to the center of the tablet, joint 2 will NOT lie to the right of joint 1).

Press the SPACE BAR.

Position 23: Rotate the arm back to the initial position. Place joint 4 approximately in the center of the tablet, so that the pointer points to the right and is approximately parallel to the tablet's bottom edge. Be sure that the base of joint 4 lies flat on the tablet surface. While the position of the arm is not critical, the position just described is the most convenient. The triangular block is not used for this position.



Position 19



Position 20

Position 21

Press the SPACE BAR.

Position 24: Rotate joint 3 so that joint 4 and the pointer twist out of the plane of the tablet by about 45 degrees. Stand the triangular block up and place it under joint 4. The base of the cylinder of joint 4 should lie flush against the triangle's hypotenuse, and the bottom edge of the triangle should lie flat on the tablet's surface. Try to keep arm segment 3 parallel to the tablet surface.

Press the SPACE BAR.

Position 25: Rotate joint 3 further until the base of joint 4 is perpendicular to the tablet surface. Place one edge of the triangle flush against the base of joint 4, and the the other edge of the triangle flat on the tablet surface. The hypotenuse of the triangle should touch neither joint 4 nor the tablet surface. Again, try to keep arm segment 3 parallel to the tablet surface.

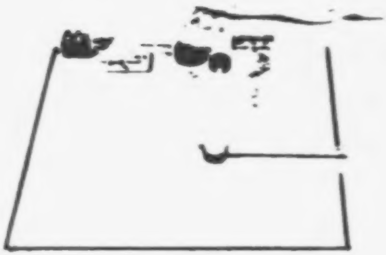
Press the SPACE BAR.

Position 26: Rotate joint 3 further so that the base of joint 4 is pointing approximately 45 degrees up to the right. Now rotate the arm so that the base of joint 4 is pointing down and to the left, WITHOUT ROTATING JOINT 3. This is a bit tricky and necessitates the vertical rotation of joint 2, followed by rotation of joint 1 in the clockwise direction, followed by rotation of joint 4 so that the pointer is not in the way (the pointer's position is not critical). The arm is now no longer in its initial position. Place the base of joint 4 flush against the hypotenuse of the triangle and the bottom edge of the triangle flat on the tablet surface. Try to keep arm segment 3 parallel with the tablet surface.

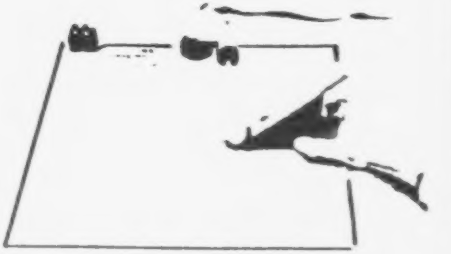
Press the SPACE BAR.

Position 27: Continue rotating joint 3 until the base of joint 4 lies flat on the tablet surface. When done properly, joint 4 should lie flat on the tablet surface, near the center of the tablet, and joint 2 should lie to the left of joint 1.

Position 22



Position 23



Position 24

BEST COPY AVAILABLE

ecalibrate. Accurate calibration is critical for the proper and ccurate functioning of the SPACE TABLET™. Follow the bove directions and consult the diagrams carefully!

NOTE: The calibration data stored in the CALIBR.DAT file must be acknowledged by the computer prior to using the SPACE TABLET™. The computer will recognize this data only if the CALIBR.DAT file is present in the PROGRAM DISK DRIVE when INGRAPH is invoked (you may specify any PROGRAM DISK DRIVE using the configuration program – normally it will be A:). Since the calibration data was stored on he INGRAPH disk (the PROGRAM DISK), it will always be present in the PROGRAM DISK DRIVE. If the CALIBR.DAT ile was not saved on the INGRAPH disk, you should do one of the following:

(1) Copy the CALIBR.DAT file onto the INGRAPH disk.

(2) Insert the UTILITIES disk into drive A and the INGRAPH disk into drive B and turn the machine on. To run the programs on the INGRAPH disk, just type B:INGRAPH and press ENTER. (This assumes that the PROGRAM DISK DRIVE set in the CONFIGURE program is A:.)

Press the SPACE BAR.

Position 28: Rotate the arm back to the initial position (joint 2 to the right of joint 1 with joint 4 in the center of the tablet). Move the pointer tip so that it just touches the right side of the bottom edge of the tablet. It does not matter where on the right side of the tablet the pointer tip lies, as long as it lies well on the right side and just touches the bottom edge. You may find it easier to place the triangular block flush against the tablet's bottom edge and bring the pointer up against the side of the block. The right angle of the triangular block insures that the pointer tip extends to the bottom edge of the tablet (see diagram).

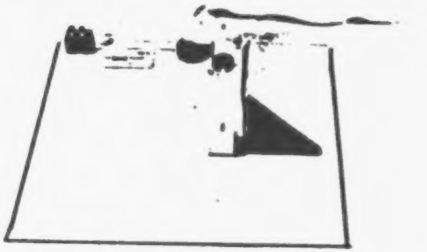
Press the SPACE BAR.

Position 29: Move the pointer tip so that it lies on the bottom edge of the tablet (as in position 28) but on the LEFT side. Again, the exact tip position is not critical – as long as it lies well on the left side of the bottom edge. As in position 28, the triangular block may be used to minimize any error inherent in manually placing the pointer at the bottom edge of the tablet.

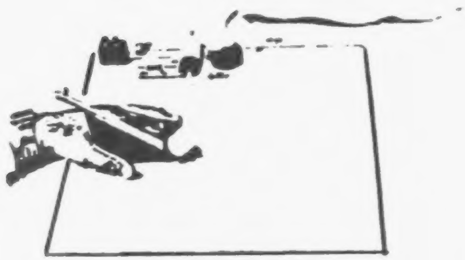
Press the SPACE BAR.

Once the data has been entered for position 29, the calibration procedure is completed and the data for the calibration will automatically be stored on disk. When the disk drive use indicator (the red light) goes off, the SPACE TABLET™ is ready for use.

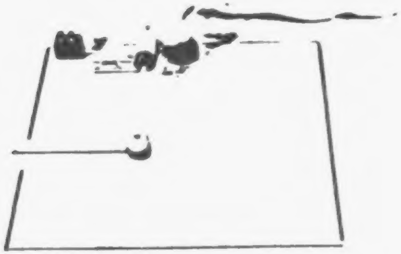
The calibration data is stored on the INGRAPH disk as a file called CALIBR.DAT. This file can be copied to other disks. Since the calibration data is saved on disk, you needn't calibrate the tablet each time you work with the ADVANCED SPACE GRAPHICS™/SPACE TABLET™ system. Since each calibration stores the data over the previous calibration data, the tablet can (and should) be recalibrated when necessary. If the accuracy of the tablet seems to be considerably off, or you seem to be getting "funny" results, go back to the tablet and



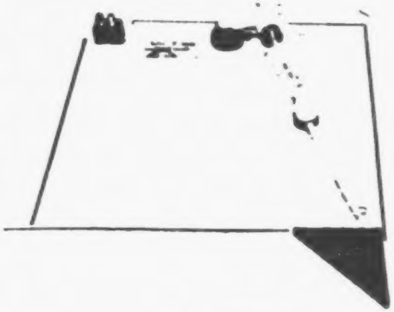
Position 25



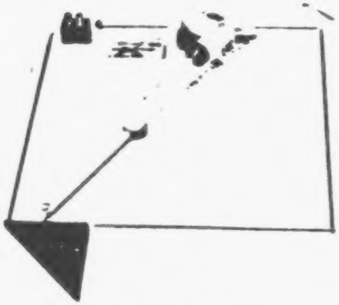
Position 26



Position 27



Position 28



Position 29

UNIVERSITY OF
NORTH DAKOTA
DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 5

LAP TITLE: Advanced Space Graphics Software Package and the Coordinate systems used

PREREQUISITE LAP (S) : CADD 4

LAP PURPOSE: to familiarize the Advanced Spaced Graphics software and the different coordinate systems used with the package.

COMPETENCIES TO BE DEVELOPED:

1. To describe the functions of the three Advanced Space Graphics disks.
2. To select the proper disk for a given CADD task.
3. To identify the coordinates of any point with regard to the display screen, the 2-D tablet, the 3-D tablet, and the drawing object.
4. To convert graphic data among the three different coordinates. (The tablet, the user and the screen coordinates)

Software Package (Advanced Space Graphics)

The Advanced Space Graphics software consists of three disks: (1) INGRAPH, (2) OUTGRAPH, and (3) UTILITIES.

Applications: creation and manipulation of 2-D and 3-D drawings

Input: coordinate input from: (1) 3-D space tablet, (2) MSC 2-D tablet and (3) keyboard.

FUNCTIONS: rotation, scaling, moving, editing, dimensioning, adding text, listing, files, printing files, generation of orthogonal projection and perspective views, creation of arcs, polygons, and constructing drawings via printer or plotter.

FORM OF DRAWING: wireframe drawing with max. 2000 points and 2500 lines.

CAPABILITY: storing figures (complete drawings) subfigures (components of of a drawing); retrieving figures, subfigures whenever they are needed; selectively activating files at desired levels.

DETAILS OF THE THREE DISKS

1. INGRAPH : constructing graphs
entering data
general design functions
access to drawing files
storing files

2. OUTGRAPH: output graphs via printer or plotter
dimesnsioning & labeling graphs
general design functions
access to drawing files
storing files

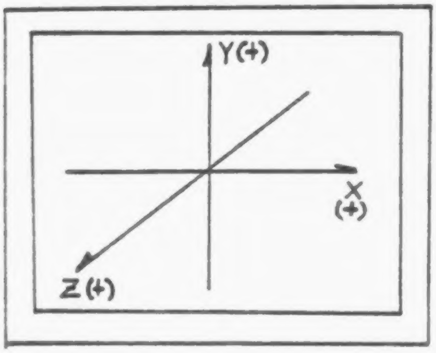
3. UTILITIES: configuration set
3-D Space Tablet
other functional checks

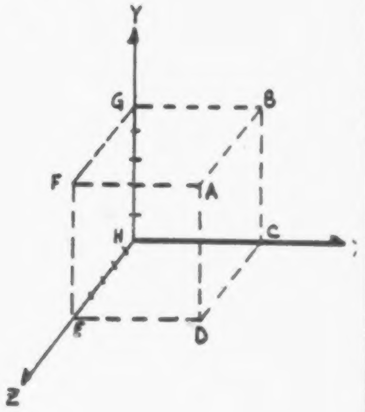
THE ADVANCED SPACE GRAPHICS

COORDINATE SYSTEM

The Advanced Space Graphics uses a standard right-handed cartesian coordinate system.

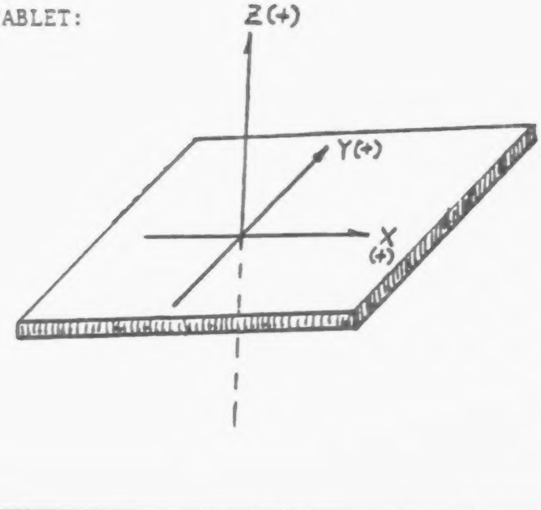
1. SCREEN:

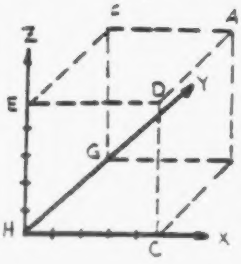




P(X,Y,Z)
A(5,5,5)----X Y Z space
B(5,5,0)----X Y plane
C(5,0,0)----X axis
D(5,0,5)----X Z plane
E(0,0,5)----Z axis
F(0,5,5)----Y Z plane
G(0,5,0)----Y axis
H(0,0,0)----Origin

2. SPACE TABLET:





A(5,5,5) ----------X Y Z SPACE

B(5,5, 0)----------X Y AXIS

C(5, 0, 0)---------X AXIS

D(5, 0, 5)---------X Z AXIS

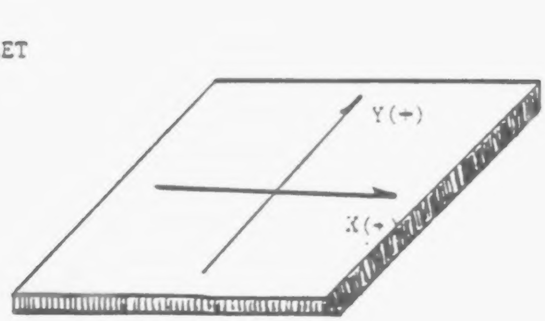
E(0, 0, 5)---------Z AXIS

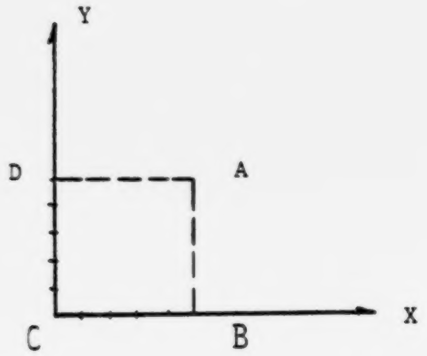
F(0, 5,5)----------Y Z AXIS

G(0, 5, 0)---------Y AXIS

H(0, 0, 0)---------ORIGIN

3. MSC 2-D TABLET





P(X ,Y)

A(5,5) -----------X Y PLANE

B(5, 0)----------X AXIS

C (0,0)-----------ORIGIN

D (0, 5)---------Y AXIS

ORIGIN OF THE SYSTEMS

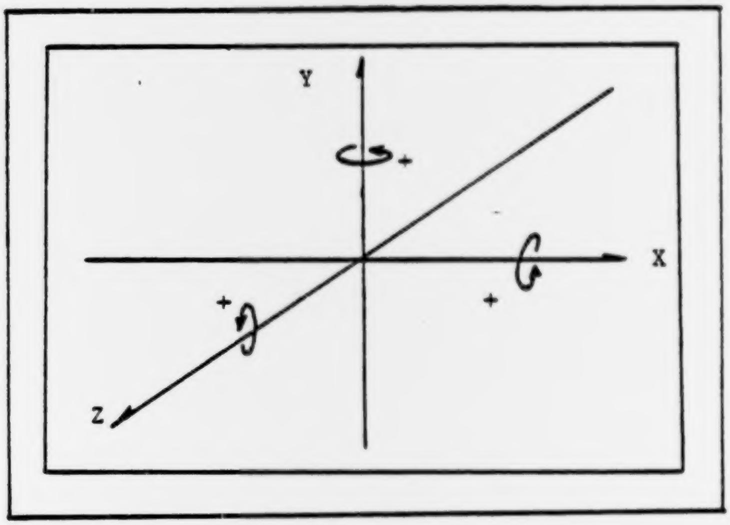
1. SCREEN: CENTER OF THE SCREEN(FIXED)

2. SPACE TABLET: CENTER OF THE TABLET
(IT CAN BE RELOCATED)

3. MCS 2-D TABLET: CENTER OF THE TABLET
(FIXED)

ROTATION DIRECTIONS

It is very important when a transformation function rotation is manipulated on the screen.



POSITIVE ROTATION: Assume a screw is turned if it is to be inserted along an axis.

NEGATIVE ROTATION: Assume the direction of removing the same screw.

DIFFERENT COORDINATES

There are three types of coordiantes used to represent data in the Advanced Space Graphics system.

They are: The Tablet Coordinates (World Coordinates)
The User Coordiantes
The Screen Coordinates

1. Tablet Coordiantes: (both space tablet and MCS 2-D Tablet)

   real world coordiantes in Inches
   used in digitizing an object or creating a drawing

2. User Coordinates: In UNITS

   X,Y,Z values stored in the computer
   those values are displayed under LIST file
   Those values can be printed out

3. Screen Coordinates
   The actual representation of the coordinate data on the monitor screen.

Relationship Equations:

USER= TABLET * T-SCALE
SCREEN= USER * ZOOM
SCREEN = TABLET * T-SCALE * ZOOM

* Space Tablet Size approx. corresponds to the screen pixels, therefore the default zoom factor is 20.

13.5 " by 16" ----------> 270 by 320 pixels
(actual visible : 176 x 320)

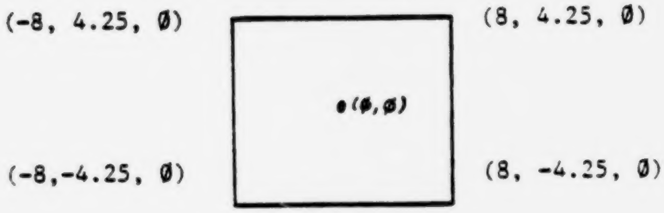
* Space Tablet Movement corresponds to the user unit
Therefore the default T-scale is 1
1" movement on the tablet will indicate 1 unit value

EXAMPLE:

1. An object has a base size of 8.5 " x 16" without change the T-scale and zoom factor

   The drawing of the X,Y orientation should be displayed approx. the full screen.

   The user coordinates of four corners should be



72-2

UNIVERSITY OF
NORTH DAKOTA
DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 6

LAP TITLE: General Operating Procedures and the Major CADD Functions

PREREQUISITE LAP (S) : CADD 5

LAP PURPOSE: To familiarize operating procedures of running the Advanced Space Graphic hardware and software.

COMPETENCIES TO BE DEVELOPED:

1. To make back-up copies of the software disks.
2. To operate various machine level functions, such as: DOS commands.
3. To perform some basic CADD tasks, such as: main menu, sub menu, etc.

GENERAL OPERATING PROCEDURES

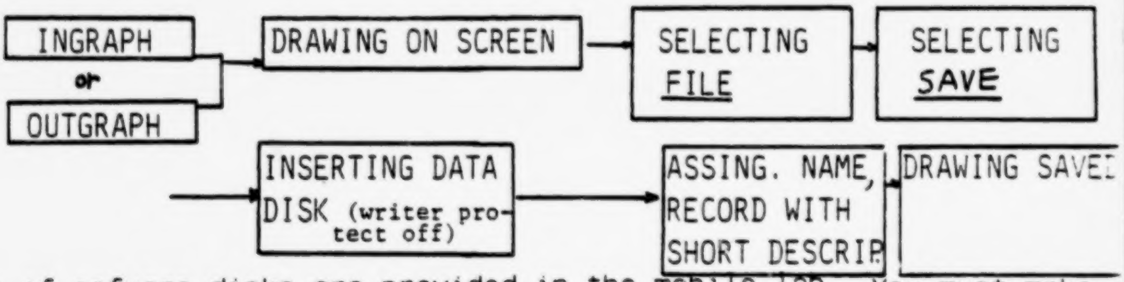
If you don't need to copy program disks, or format data disks, you can skip steps 2 and 3. (Go directly from step 1 to step 4)

1. Turn on the computer , monitor, printer, plotter
* 2. Copy disks : RUN DOS 1.1, >A DISKCOPY a:/1 (back-up copyies,writer protect them)
** 3. Format a blank disk for storing drawings : Run DOS 1.1, A> FORMAT a:/s/1 , ENTER (This is the data disk for your use).
4. Insert the INGRAPH (or OUTGRAPH) disk (Depends on the funcions you want to use.)
5. Press CTRL+ALT+DEL, ENTER
6. Enter the date and time as computer asks
7. When the system promtly show A>, type INGRAPH (or OUTGRAPH) , ENTER
8. Press ENTER to view the main menu only
9. Use Function Keys to select option number (see the complete tree, p. 166)

F -----> F -------> F deeper to the function you select
F10 ----------> F10 ---------> F10 back to the higher level menu
F10 ------> F9 back to the main menu

10. Use F key to input provided values
11. Use − & F key to input negative provided values (don't use the number pad keys)
12. Use the number key and ENTER to input desired values. (don't use the number pad keys)

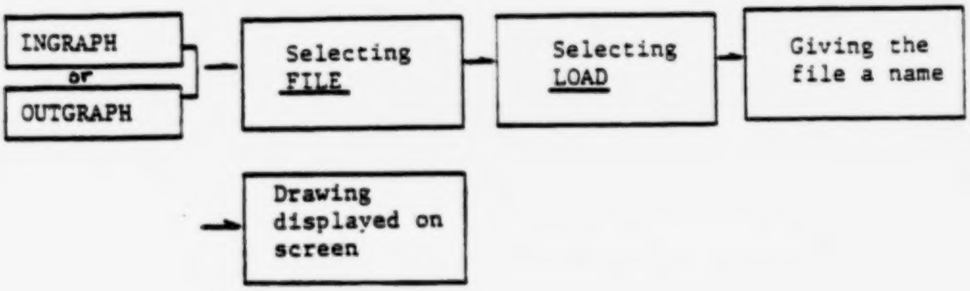
13. To save a drawing:


INGRAPH
or
OUTGRAPH
DRAWING ON SCREEN
SELECTING FILE
SELECTING SAVE
INSERTING DATA DISK (writer protect off)
ASSING. NAME, RECORD WITH SHORT DESCRIP
DRAWING SAVE

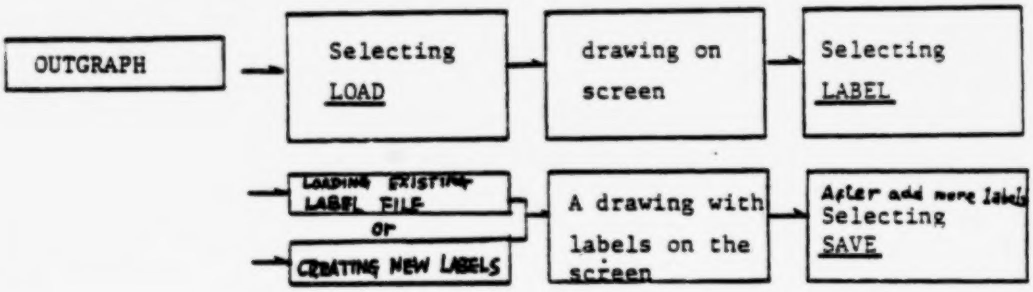
* Two sets of sofware disks are provided in the mobile lab. You must make a complete set (3) of back-up copies first. (Detail procedure is on page 74-3.)

** Please do this before you start the Advanced Space Graphics Systems. Detail procedure is on

To LOAD a drawing:



14. To add text and dimensions to a drawiwng:


OUTGRAPH
Selecting LOAD
drawing on screen
Selecting LABEL
LOADING EXISTING LABEL FILE
or
CREATING NEW LABELS
A drawing with labels on the screen
After add more labels Selecting SAVE

15. Go through other functions

16. Shut off all power(s)
    computer
    monitor
    printer
    plotter

17. Remove disk and place it in a safe place.

5-85

How To Start the IBM PC

1. Turn on the monitor.

2. Turn on the IBM power switch. (The switch is located on the right hand side of the computer unit.)
    a. The cursor will appear on the screen in approximately four seconds.
    b. One short beep will be heard after memory is tested.
    c. The IBM Personal Computer message will appear on the screen.

3. Insert the IBM DOS 1.1 disk in the disk drive and close the drive door.

4. Press /CTRL/ + /ALT/, /Del/ three keys. (Holding the <CTRL> and the <ALT> keys, then pressing the <Del> key.)

5. The DOS is ready, a prompt A> is displayed.

6. At this point you can:
    *a. backup your program disks.
    *b. format data disk(s).
    *c. calibrate the 3-D tablet (UTILITY).
    d. Start the Advanced Space Graphics System (INGRAPH OR OUTGRAPH).

*Steps a, b, c are needed to go through only under the following situations:
(i) The first time you use the system.
(ii) When they are needed, such as: the 3-D tablet is out of calibration, make additional data disk(s), etc.

5-85

How to Make Back-up Copies of the Three Advance Space Graphics Disks

1. Turn on the monitor.

2. Turn on the IBM power switch.
   a. The cursor will appear on the screen in approximately 4 seconds.
   b. One short beep will be heard after memory is tested.
   c. The IBM Personal Computer message will appear on the screen.

3. Insert the IBM DOS 1.1 disk in the disk drive and close the drive door.

4. Press /CTRL/ + /ALT/, /Del/ three keys. (Holding the <CTRL> and the <ALT> keys, then press the <Del> key.)

5. The DOS is ready, a prompt A> is displayed.

6. Type DISKCOPY A:/1 then press /Enter/ key.

7. The screen will display: Insert Source Diskette in Drive A, and Strike Any Key When Ready.

8. Remove the IBM DOS 1.1 disk, and insert the INGRAPH (or OUTGRAPH, or UTILITY) disk, then press /ENTER/ key.

9. After the drive is running for a while, the screen will display: Insert Target Diskette in Drive A, and Strike Any Key When ReadY.

10. Remove the INGRAPH (or OUTGRAPH, or UTILITY) disk, and Insert a blank disk, then press /ENTER/ key.

11. After the drive is running for a while, a back-up copy is made.

12. You can make additional back-up copies by following the prompted messages and go through steps 8, 9, 10, and 11.

13. After all back-up copies are completed, you can shut off the system.

14. Or, you can insert the INGRAPH (or OUTGRAPH, or UTILITY) disk which you have made in the disk drive.

15. Press /CTRL/ + /ALT/, /Del/ three keys to start the Advanced Space Graphics program.

*Make sure to write protect the back-up copies which you made.

5-85

How To Format A Data Disk

1. Turn on the monitor.

2. Turn on the IBM power switch.
   a. The cursor will appear on the screen in approximately 4 seconds.
   b. One short beep will be heard after memory is tested.
   c. The IBM Personal Computer message will appear on the screen.

3. Insert the IBM DOS 1.1 disk in the disk drive and close the drive door.

4. Press /CTRL/ + /ALT/, /Del/ three keys. (Holding the <CTRL> and the <ALT> keys, then press the <Del> key.)

5. The DOS is ready, a prompt A> is displayed.

6. Type F O R M A T _ A : / s/1 then press /ENTER/ key.

7. Follow the instrution displayed to insert a blank disk and format it.

8. After the formatting process is completed, label the disk as:
   DATA DISK FOR ADVANCED SPACE GRAPHICS
   School name: ______________________
   Date: ____________

9. You can make additional data disks by following the prompted messages.

10. After all necessary data disks are made, you can shut off the system.

11. Or, you can insert the INGRAPH (or OUTGRAPH, or UTILITY) disk in the disk drive.

12. Press /CTRL/ + /ALT/, /Del/ three keys to start the Advanced Space Graphics program.

*The data disk you formatted will be used to save (store) drawings you generate in the future.

**Drawings saved in the data disk can be loaded out (retrived) in the future for futher imaging process.

Procedures of CAD (Advance Space Graphics) Demonstrations

8-9-84
By: Wan-Lee Cheng
Lawrence Siu

5-20-85

Action	Display
1. Turn on: IBM PC monitor printer plotter	1. For IBM PC: Wait to see displays on the screen.
2. Insert "OUTGRAPH" disk and close the drive door.	
3. Press /CTRL/ + /ALT/, /Del/ keys (Holding the <CTRL> and the <ALT> keys, then press the <Del> key.) Enter the "date", then the "time".	3. "Date" then "time" A>
4. Type "OUTGRAPH" enter	4. Logo and main menu
5. Press /F2/ (files)	5. "File action ?"
6. Press /F1/ (load)	6. "Load which file?" (Sample file names)
7. Press /F2/ (C2. GRA)	7. "File action?" (picture will be displayed)
8. Press /F9/	8. "Main menu"
9. Press /F1/ (T-form)	9. "T-Form action?"
10. Press /F3/ (Move)	10. "Axis of motion?"
11. Press /F1/ (X-axis)	11. "Distance of X motion"
12. Press /F2/, /F2/, /-/ /F2/, /-/ /F2/	12. drawing moved
13. Press /F10/, /F10/ (back to T-Form Menu)	13. "T-Form action?"
14. Press /F2/ (Rotate)	14. "Axis of rotation?"
15. Press /F2/ (X-axis)	15. "Angle of rotation?"
16. Press /F3/, /-/ /F3/	16. drawing rotated
17. Press /F10/, /F10/ (back to T-Form menu)	17. "T-Form action?"

18.	Press /F1/ (scale)	18.	"Scale axis?"
19.	Press /F1/ (all)	19.	sample scales given
20.	Press /F5/, /F5/, /F5/	20.	drawing scaled down
21.	Press /F2/, /F2/, /F2/	21.	drawing scales back to original size.
22.	Press /F10/, /F9/ (back to main menu)	22.	"Main menu action?"
23.	Press /F2/ (files)	23.	"File action?"
24.	Press /F1/ (load/	24.	"Load which file?'
25.	Insert the "UTILITIES" disk (remove the "OUTGRAPH" disk first)		
26.	Type "SHUTTLE.GRA" then press /ENTER/ key	26.	(Both shuttle and cube displayed) "File actions?"
27.	Insert the "OUTGRAPH" disk (remove the "UTILITIES" disk first)		
28.	Press /F7/ (erase)	28.	"Index of drawing to erase?"
29.	Press /F1/ (erase the cube)	29.	"File action?" (only the shuttle on the display)
30.	Press /F9/ (back to main menu)	30.	"Main Menu"
31.	Press /F4/ (output)	31.	"output device?"
32.	Press /F1/ (Epson)	32.	The printer is in action (wait for all complete and see the main menu).
33.	Press /F4/ (output)	33.	"output device?"
* 34.	Action for setting plotters: a. insert a pen and a plot paper b. Reset c. Local d. Small Chart e. Remote	34.	plotter in action
35.	Press /F4/ (Houston)	35.	"Plot format"
36.	Press /F2/ (plot-4)	36.	the plotter is in action (wait for all complete)
37.	Remove the "OUTGRAPH" disk		

38. Turn off: IBM PC
Monitor
Printer
Plotter

39. Unplug: IBM PC
Monitor
Printer
Plotter

40. ALL DONE

5-85

How to Protect Floppy Diskette

Diskettes are extremely sensitive. Here are some important tips you should introduce to your students at the very beginning.

1. Always keep a diskette in its paper envelope when not in use.
2. Store diskettes in a vertical position just like you would a phonograph record.
3. Never touch the surface of a diskette with your fingers or try to wipe the surface of a diskette with a rag, handkerchief, or other piece of cloth.
4. Keep diskettes away from extreme heat, such as that produced from ratiators, direct sun, or other heat sources.
5. Never bend a diskette.
6. Keep diskettes away from magnetic fields such as those generated by computers, televisions, monitors, digitizing tablets, plotters, printers, and other electrical devices. A strong magnetic field may erase/destroy program(s)/ data on a diskette.
7. Never remove a diskette while the drive is running. Doing so may cause permanent damage to the diskette.
8. Keep the writer protect notch covered, if there is no need to save any new program/data on the diskette.

Backing Up with One Drive

If you have only one diskette drive, you must remove the original diskette and insert the backup diskette. You will have to make this switch ("swap") four or more times. The number of times you have to swap diskettes depends on whether you're using DISKCOPY or COPY, on how large the files being copied are, and on how much memory your computer has.

DOS will tell you when you have to swap diskettes. DISKCOPY will give you these messages:

```
Insert source diskette in drive A

Insert target diskette in drive A
```

So you should:

Insert	When
Original diskette	"source" message is displayed
Backup diskette	"target" message is displayed

1. Make sure DOS is ready and `A>` is displayed.

2. Insert the DOS diskette into the drive, if it is not already there.

3. Type:

```
diskcopy a:/1
```

and press the Enter key.

4. This message appears:

```
Insert source diskette in drive A

Strike any key when ready
```

BEFORE YOU PRESS A KEY:

4A Remove the diskette that is in the drive.

4B Insert your original diskette into the drive.

4C Now press a key.

5. You will see the "in use" light come on while the original diskette is being read, and then this is displayed:

```
Insert target diskette in drive A

Strike any key when ready
```

BEFORE TOUCHING A KEY:

5A Remove your original diskette.

5B Insert the backup diskette.

5C Now press a key to tell DOS the correct diskette has been inserted.

6. You will see the "in use" light come on while the backup diskette is being written. Then the message shown in Step 4 will appear again.

Hint: For this procedure, you can remember which diskette to insert if you remember "Original = Source." Insert your original diskette when DISKCOPY asks for the source diskette.

BEST COPY AVAILABLE

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BEST COPY AVAILABLE

Before You Begin

Decide which kind of copy you want to make. Then get:

- The diskette with the file you want to copy. We'll call this the "original" diskette.
- The diskette that will have the copy of the file when you are done. This may be the same diskette as your original diskette, or it may be a different one, in which case we will call it your "backup" diskette.

Also decide on the name for the copied file.

Copying a File to the Same Diskette

For this example, let's assume that LETTER is the name of the file you want to copy, and that the copy's name will be MEMO.

Recall that you need a different name because every name on a diskette must be unique. You might want to check that the name you have chosen isn't already being used, unless you really mean to **replace** that file. For this example, check by typing: dir memo

Let's do it.

1. Make sure DOS is ready and **A>** is displayed.
2. Insert the original diskette (the diskette with LETTER) in drive A.
3. Type

```
copy letter memo
```

and press Enter.

Notice that in the command, you type the original filename first and the backup filename second.

4. After a while (depending on how long the file LETTER is), you will see this on the screen:

```
1 File(s) copied
A>
```

5. LETTER has been copied, and the copy has been given the filename MEMO.

You can use the DIR command to check, by typing

```
dir memo
```

Now press the Enter key.

6. Remove the diskette and put it away in its envelope because we are through with this example.

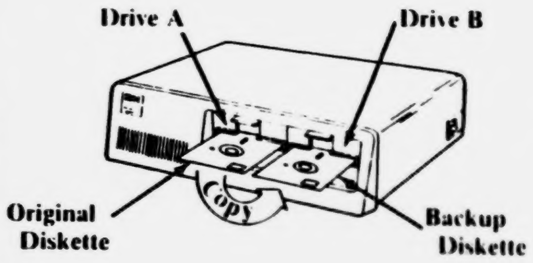
Copying a File to Another Diskette Using One Drive

Remember, with only one diskette drive, you will need to exchange diskettes while COPY is running. DOS will tell you when the change must be made by showing you a message.

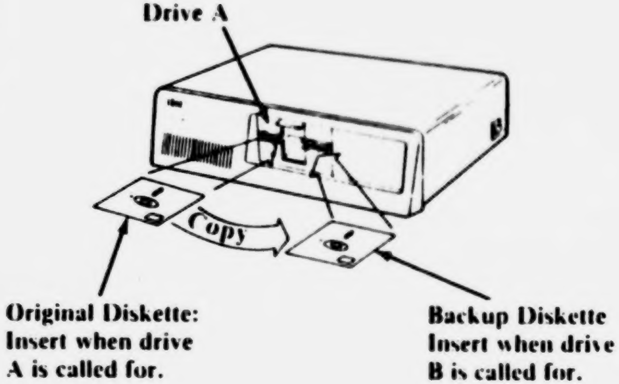
The messages for COPY sound as if you had two drives instead of one. You should think of the messages as referring to diskettes instead of drives.

For our examples, think of your original diskette as the "drive A" diskette, and the backup diskette as the "drive B" diskette. (Even though you have no drive B, the command is the same for one drive or two. The computer keeps track of the real drive A and the "imaginary" drive B.)

If you had two drives



But with one drive


Drive A
Copy
Original Diskette: Insert when drive A is called for.
Backup Diskette Insert when drive B is called for.

So you should:

Insert	When
Original diskette	"drive A" message appears
Backup diskette	"drive B" message appears

Let's assume that the file you want to copy is LETTER. For this example, we are going to copy LETTER to another diskette without changing its name.

1. Make sure DOS is ready and **A>** is displayed.
2. Insert the diskette with LETTER (the original diskette) into your drive.
3. Type:

   ```
   copy letter b:
   ```

   and press the Enter key.

   Notice again where the spaces are.
4. This message is displayed:

   ```
   Insert diskette for drive B: and strike
   any key when ready
   ```
5. Remove the original diskette. (But don't put it away - you may need it soon.)
6. Insert the backup diskette in drive.
7. Now press a key to tell DOS that the diskettes have been switched.
8. Depending on the size of the file being copied (LETTER, in this example) and your computer's memory, you may see this message:

   ```
   Insert diskette for drive A: and strike
   any key when ready
   ```

BEST COPY AVAILABLE

If you do see the message:

8A Remove the backup diskette from the drive.

8B Insert the original diskette in the drive.

8C Press a key.

8D Now go back to Step 4.

Hint: It's easier to remember which diskette to insert if you think "B is for backup." Insert the backup diskette when the drive B message appears.

9. When the copy has been made, this message is displayed:

```
        1 File(s) copied

A> _
```

10. Remove the backup diskette from the drive and label it with a felt-tip pen.

11. Now you can put both diskettes away - LETTER has been copied to the second diskette.

For You to Try

Select a file on your DOS diskette to copy to another diskette - how about DONKEY.BAS? Keep the name the same (unless the diskette you'll put the copy on already has a file called DONKEY.BAS).

SEVERAL IMPORTANT CONSIDERATIONS

1. Always save your drawing whenever it is appropriate to avoid possible unforeseeable failures.
    a. You can save part of a drawing as subfigures and unify all subfigures as a complete drawing.

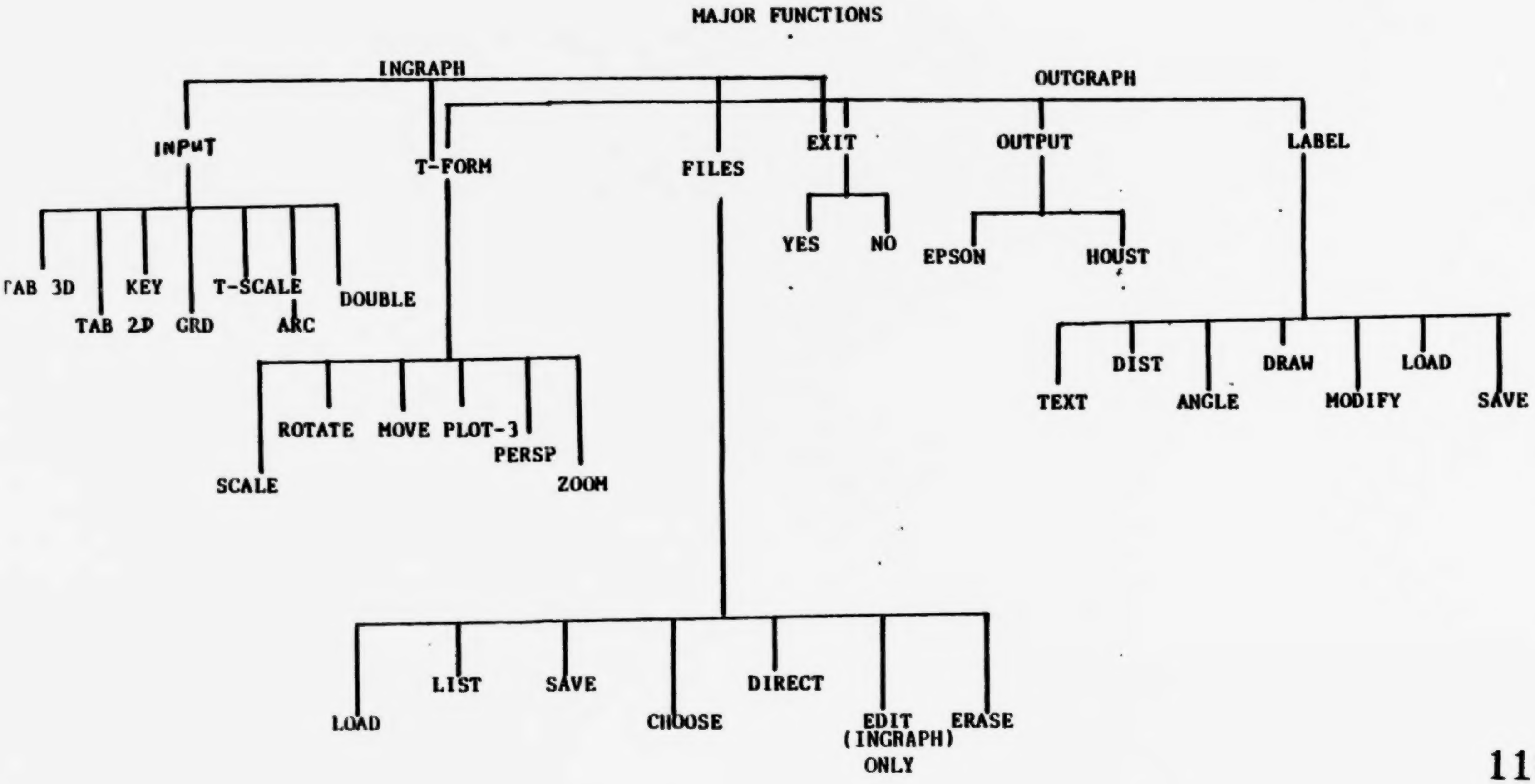
2. Well protect all system equipment.
    a. No coffee or other beverage should be nearby.
    b. Touch them with clean hands and carefully.

3. Well protect all software materials (manuals)
    a. They are life savers when any questions/problems arise.

4. Well protect all Disks.
    a. Always keep them in protective jackets when they are not in use
    b. Never touch any open magnetic surface ofthe disk.
    c. Writer protect them if you don't want any disk contents accidentally damaged.
    d. Keep disks away from dust, heat, magnetic fields.
    e. Insert and remove disks with care, never bend disks.

5. Make back up copies of those three Advance Space graphics disks. Use back up copy only.

6. Keep a good documentation of the drawing file and label file.


MAJOR FUNCTIONS
INGRAPH
OUTGRAPH
INPUT
T-FORM
FILES
EXIT
OUTPUT
LABEL
TAB 3D
TAB 2D
KEY
GRD
T-SCALE
ARC
DOUBLE
YES
NO
EPSON
HOUST
TEXT
DIST
ANGLE
DRAW
MODIFY
LOAD
SAVE
SCALE
ROTATE
MOVE
PLOT-3
PERSP
ZOOM
LOAD
LIST
SAVE
CHOOSE
DIRECT
EDIT
(INGRAPH)
ONLY
ERASE

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UNIVERSITY OF
NORTH DAKOTA
DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 7

LAP TITLE: Tutorial Lesson and the Main Menu

PREREQUISITE LAP (S) : CADD 6

LAP PURPOSE: to practice major CADD functions via the tutorial lesson.

COMPETENCIES TO BE DEVELOPED:

1. To run through six CADD functions of the main menu.
2. To understand various sub CADD functions which are branches of the main menu.
3. To familiarize the concepts and practices of graphic transformation techniques.
4. To describe capacities and limitations of the Advanced Space Graphics system.
5. To operate the Advanced Space Graphics system himself/herself without others help.

TUTORIAL LESSON

(Please see examples on p. 85 - p. 107)

1. Run INGRAPH to operation level (see p. 73 steps 1, 4, 5, 6, 7, 8, 9, 10)
2. FILES (M) → LOAD (2) : C2.GRA (A cube) (1 at corner)
3. T-FORM (M)
    a. ROTATE (2) X 30° → Y 30° → Z 30° Y 30° → X 30°
    Z -30° → Y -30° → X -30°
    b. MOVE (2)
    X +4 → X -4 → X -4 → X +4 This is the graph used for the rest of the examples
    Y +2 → Y -2 → Y +4 → Y -8 → Y +4
    Z +5 → Z -10 → Z +5 (no visual change)
    c. PLOT-3 (2)
    d. PERSP (2) Z(POS) 10 → Z(POS) 5 → (POS) INFIN
    (It was INFIN starting on the screen)
    (The nearer the more change in visual)
    e. ZOOM (2) 40 → 20 → 5 → 1 → 20
4. FILES (M) → LIST (2) → BRIEF (3)
    TOTAL (3) CTRL + NUM LOCK to Pause
5. FILES (M) → LOAD (2) : C1. GRA (a circle) (2 at corner)
    (2 colors)
6. T-FORM (M) (notice the active file)
    a. MOVE (2) X +2 → PLOT - 3 (2)
    b. ROTATE (2) X 45° → PLOT - 3 (2)
    c. ROTATE (2) X -45°
    d. PERSP (2) Z(POS) 5 , Z (POS) INFIN
    e. ZOOM (2) 40 → 20 → 5 → 1 → 20
7. FILES (M) → LIST (2) → BRIEF (3) (Notice index #)
    (2 lists)
8. CHOOSE (2) → ALL (3)

9. T-FORM (M) (notice both are active, 0 at the corner)

   a. MOVE (2) X +2 (notice both are moving)

   b. ROTATE (2) X (+90° step 10) → X -90°

10. FILES (M) → CHOOSE(2) → 1 (3)

11. FILES (M) → LIST (2) → BRIEF (3) (notice 2 lists)

12. ERASE(2) → 1 (3) (notice 0 at corner)

13. ERASE (2) → 1 (3) (After the erase, the next inactive one will become '1' as active)

14. FILES (M) → LOAD (2) : C1. GRA (a circle)

15. INPUT (M) → DOUBLE(2) → SIMPLE (3)

16. T-FORM (M) (notice only one will move)

    MOVE (2) X +4

17. T-FORM (M) → PLOT -3 (2)

18. FILES (M) → LIST(2) → BRIEF(3) (notice 2 lists)

19. INPUT (M)

    a. TAB - 3D (2) → ADD (3)
       NEAR (4)
       MOV. PT (4)
       LINE (4)
       LINE (4)

    b. KEYBD (2)
       P (3) or a SPACE BAR for point
       L (3) for line
       U (3) bring two cursors together
       E (3) erase a line

(move cursor by number pad keys)
(once space bar is hit, the cursor only moves along the drawing)

20. FILES (M) --► LIST(2)-----► TOTAL (3) (write down index # of any two lines)

21. EDIT (2) ---► DELETE(3)
LINE (4)-------►(index #) (5)

22. FILES (M) --►ERASE(2) ---►ALL (3)

23. Insert the OUTGRAPH and return to main menu.

24. LABEL(M) (notice a possible SAVE warning) (If you ask for LABEL with the INGRAPH Disk in the drive)

25. FILE(M) --►LOAD(2) : C2. GRA (a cube)

26. LABEL(M) --► LOAD(2) : C2 LAB (text and dimensions)

27. MODIFY(2) --►REJECT(3) (erase labels one by one)

28. TEXT (2) ---►(type in THIS IS A CUBE), $\boxed{\text{Enter}}$
(move cursor and press SPACE BAR)

DIST(2)----► CURSOR (3) SPACE BAR
YES (4) -- move to second point
3D (5)---- give dimension location

29. FILES (M)
SAVE (2) : TRY 1 (insert DATA disk)

30. FILES (M) ---►LABEL(2) ---►SAVE(3) : TRY 1 LAB

40. DIRECT (2) (notice the TRY 1 and TRY 1.LAB on the directory)

41. Shut off the system

42. Insert the OUTGRAPH and run it to operational level

43. FILES(M) --►LOAD (2) : TRY 1 (insert the DATA disk)

44. OUTPUT (M) ---►EPSON (2)

45. HUSTN (2) ——→ PLOT -4 (3)

46. Press CTRL + ALT + DEL at the same time to boot up to system level.

A>E R A S E T R Y 1 (See TRY 1 is no longer on the directory)

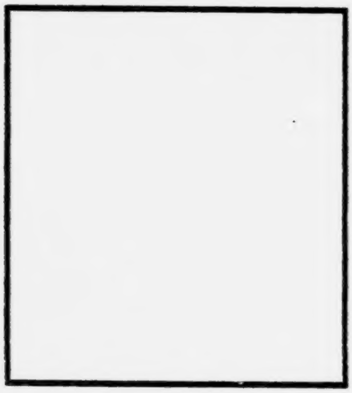
47. A>D I R

48. Remove the disk and turn off the entire system.

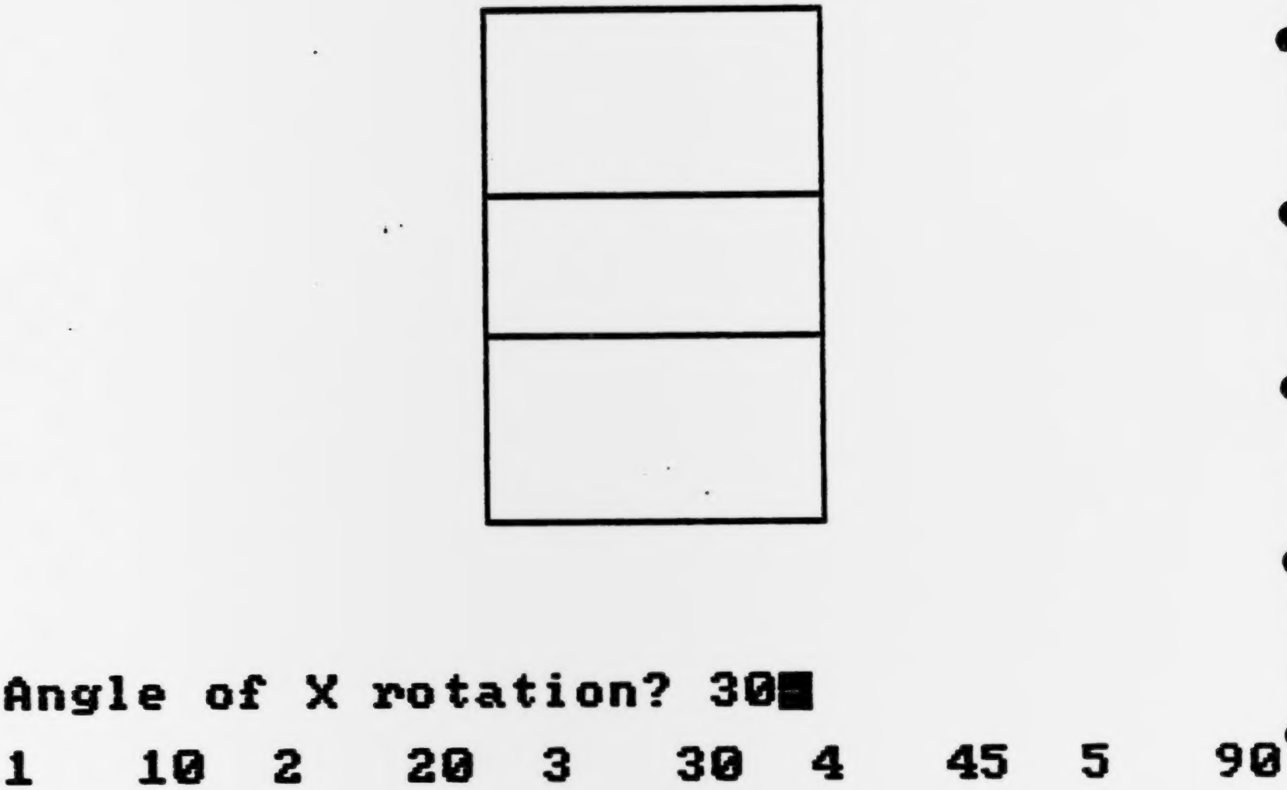
*** Letter or number in ( ) immediately after the function shows the level of functions,

For example (M) Main Menu

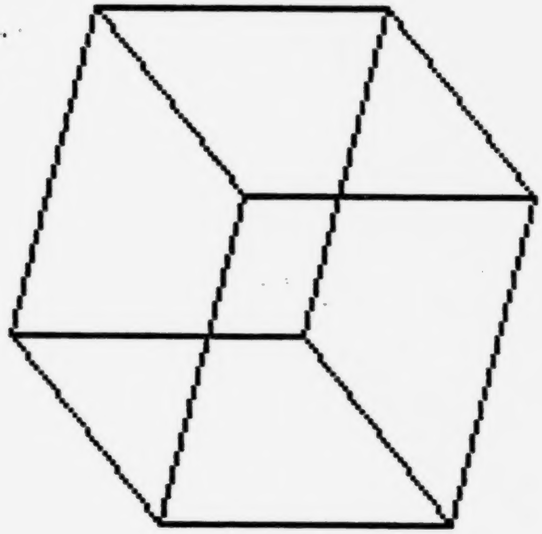
(2) Level 2, ect.



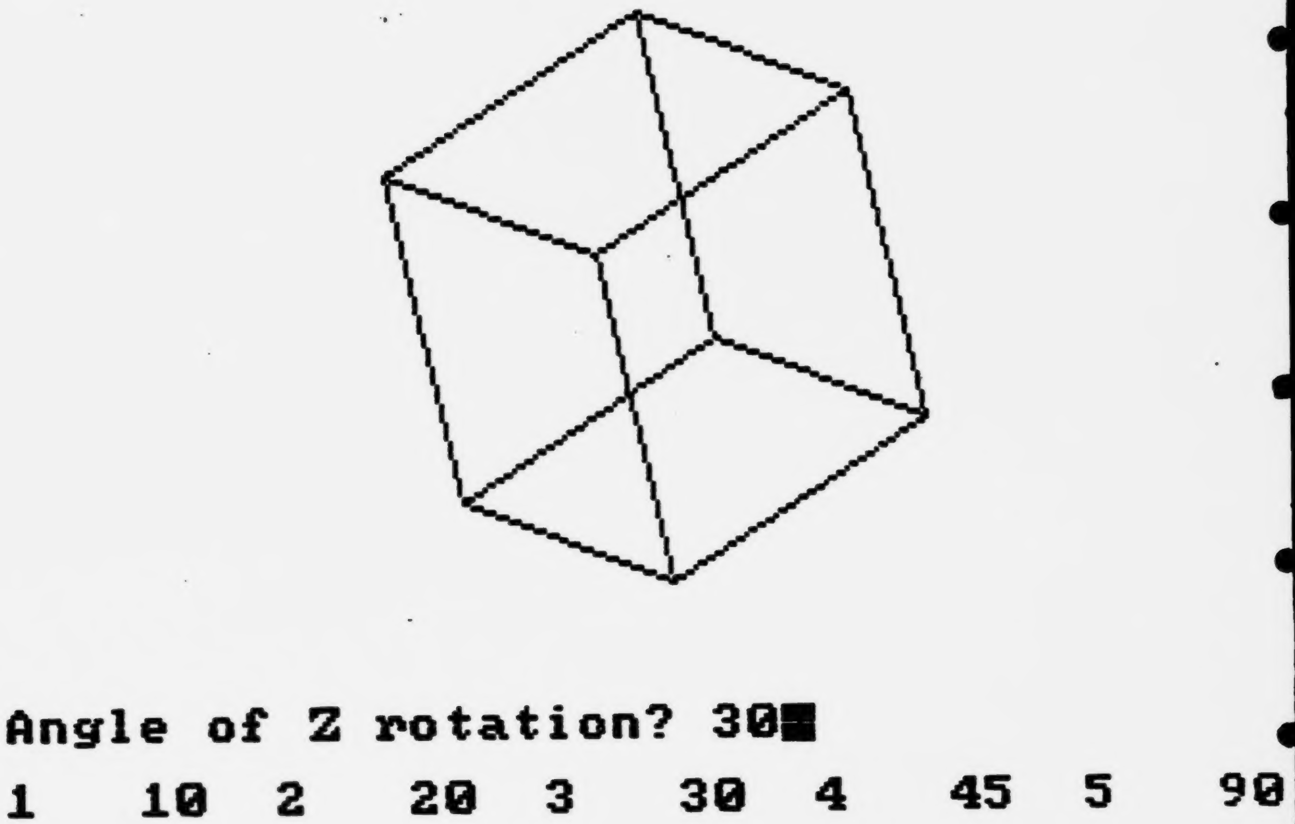
```
Angle of X rotation? █
1    10   2    20   3    30   4    45   5    90
```



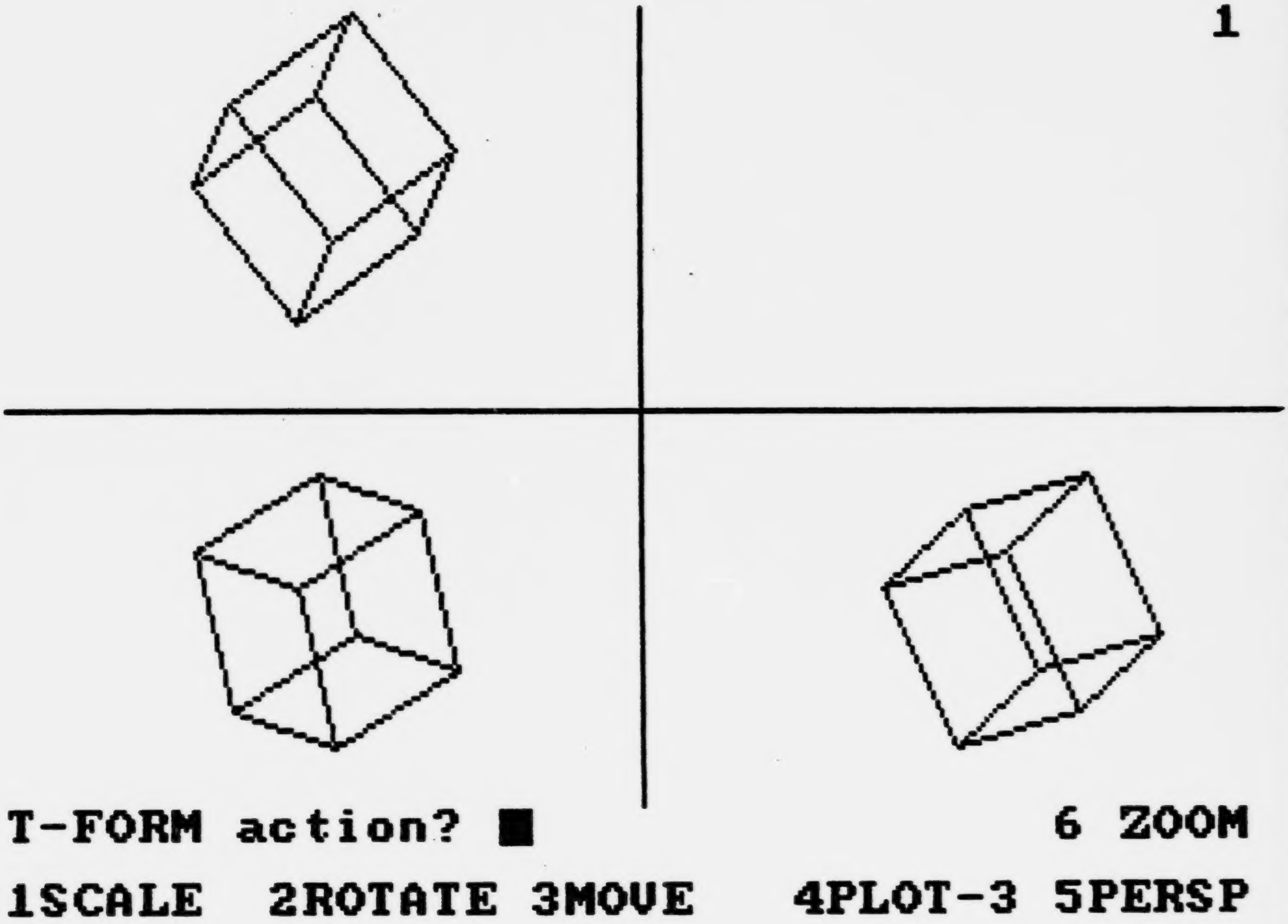
```
Angle of X rotation? 30█
1   10  2   20  3   30  4   45  5   90
```



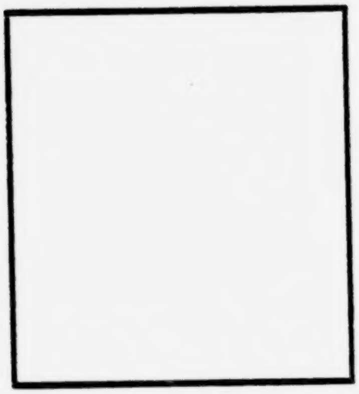
```
Angle of Y rotation? 30█
1    10   2    20   3    30   4    45   5    90
```



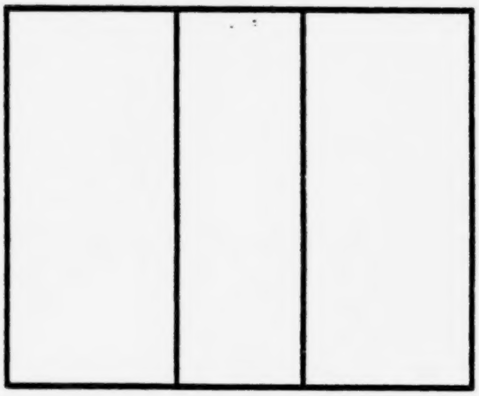
```
Angle of Z rotation? 30█
1    10   2    20   3    30   4    45   5    90
```



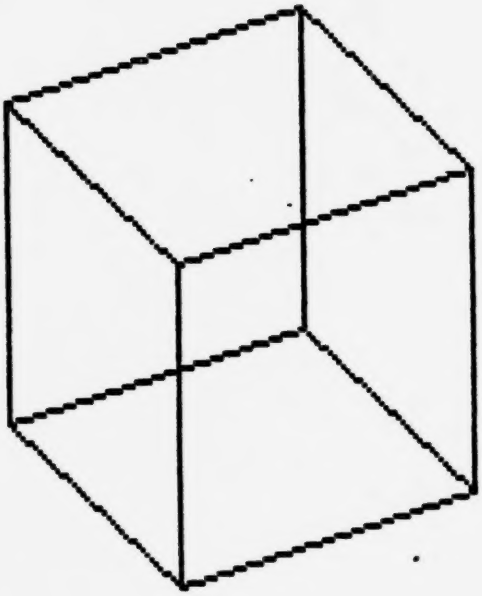
```
T-FORM action? ■                              6 ZOOM
1SCALE  2ROTATE 3MOVE   4PLOT-3 5PERSP
```



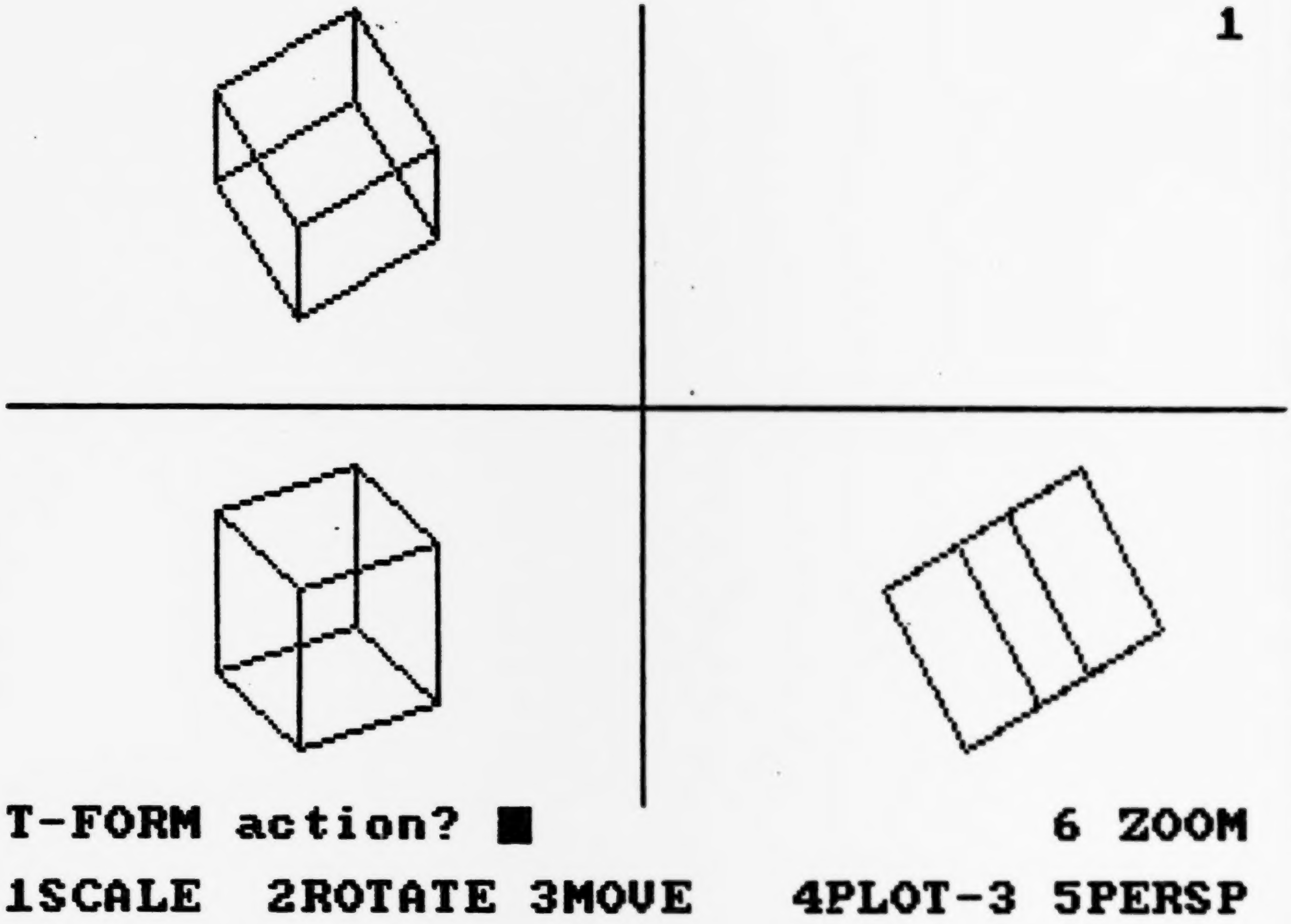
```
Angle of X rotation? █
1    10   2    20   3    30   4    45   5    90
```



```
Angle of Y rotation? 30█
1   10  2   20  3   30  4   45  5   90
```



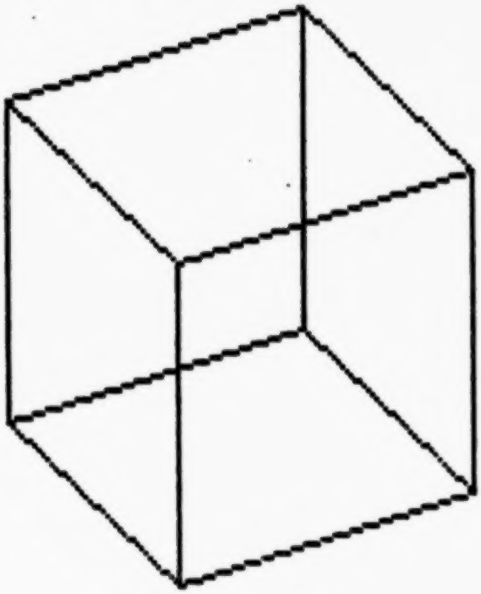
```
Angle of X rotation? 30█
1    10   2    20   3    30   4    45   5    90
```



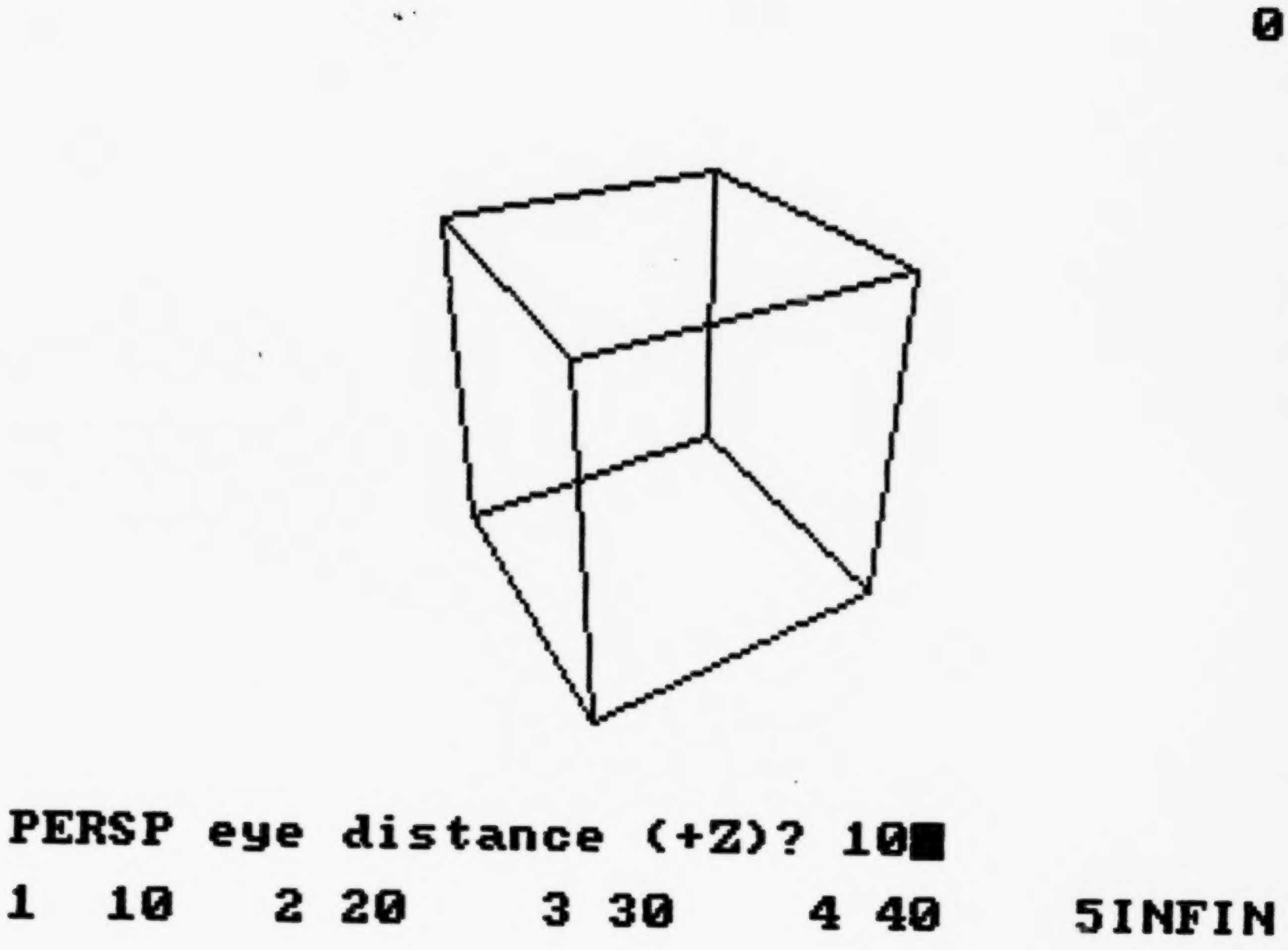
```
                                                  1

T-FORM action? ■                             6 ZOOM
1SCALE  2ROTATE 3MOVE   4PLOT-3 5PERSP
```

0

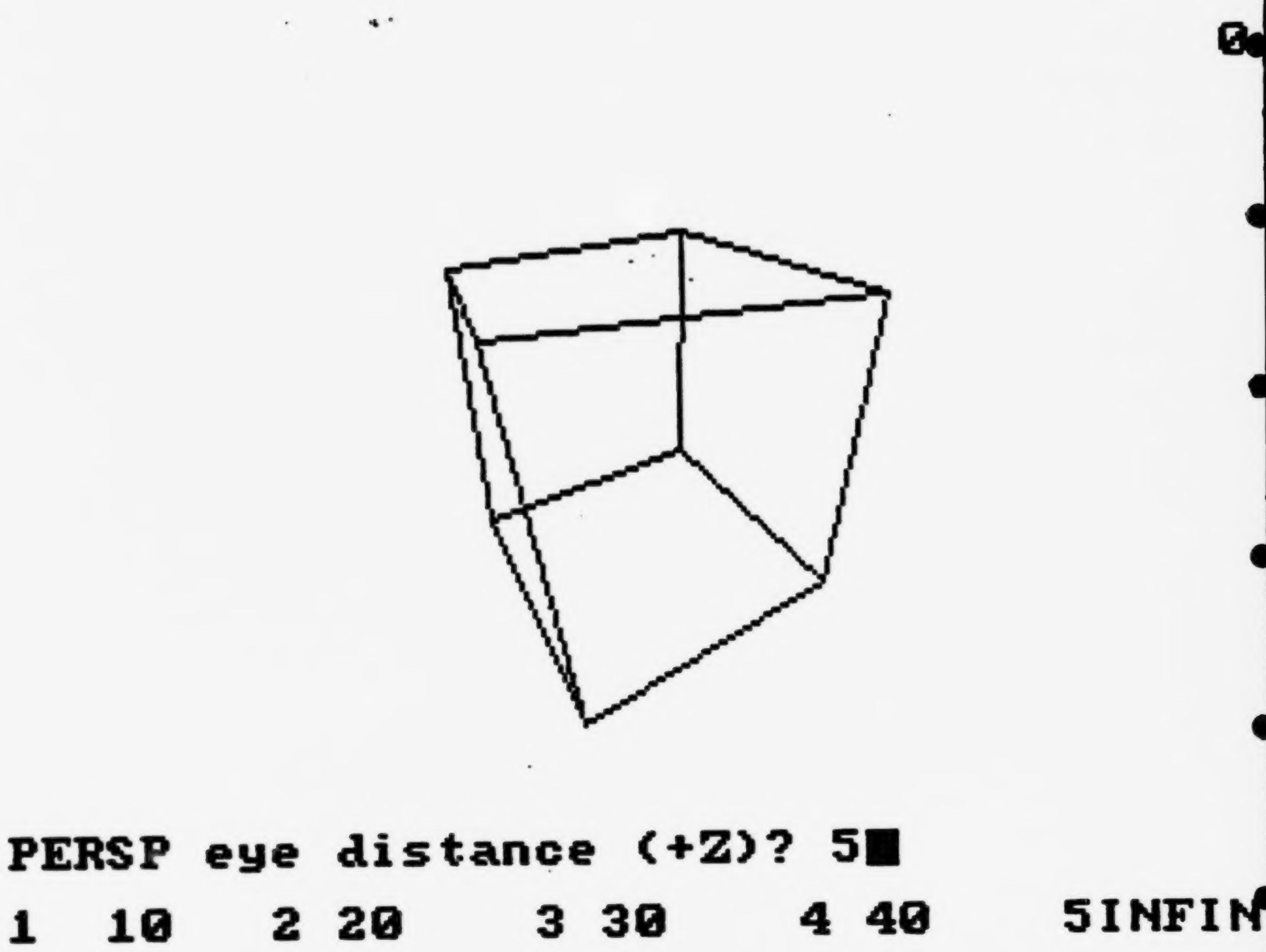


```
PERSP eye distance (+Z)? INFINITY█
1  10   2 20    3 30    4 40    5INFIN
```



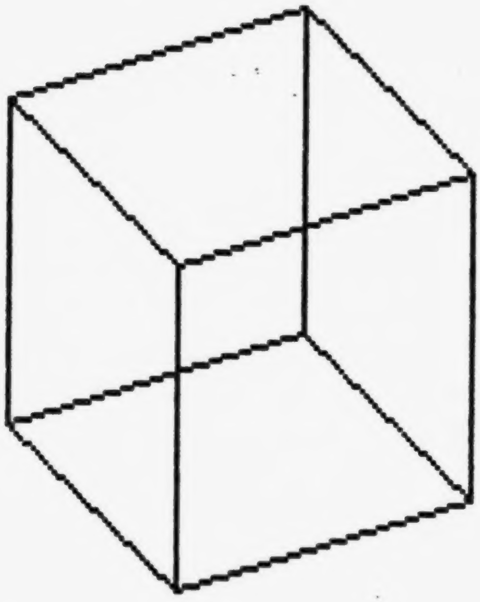
```
                                                                    0

PERSP eye distance (+Z)? 10█
1   10    2 20      3 30      4 40     5INFIN
```

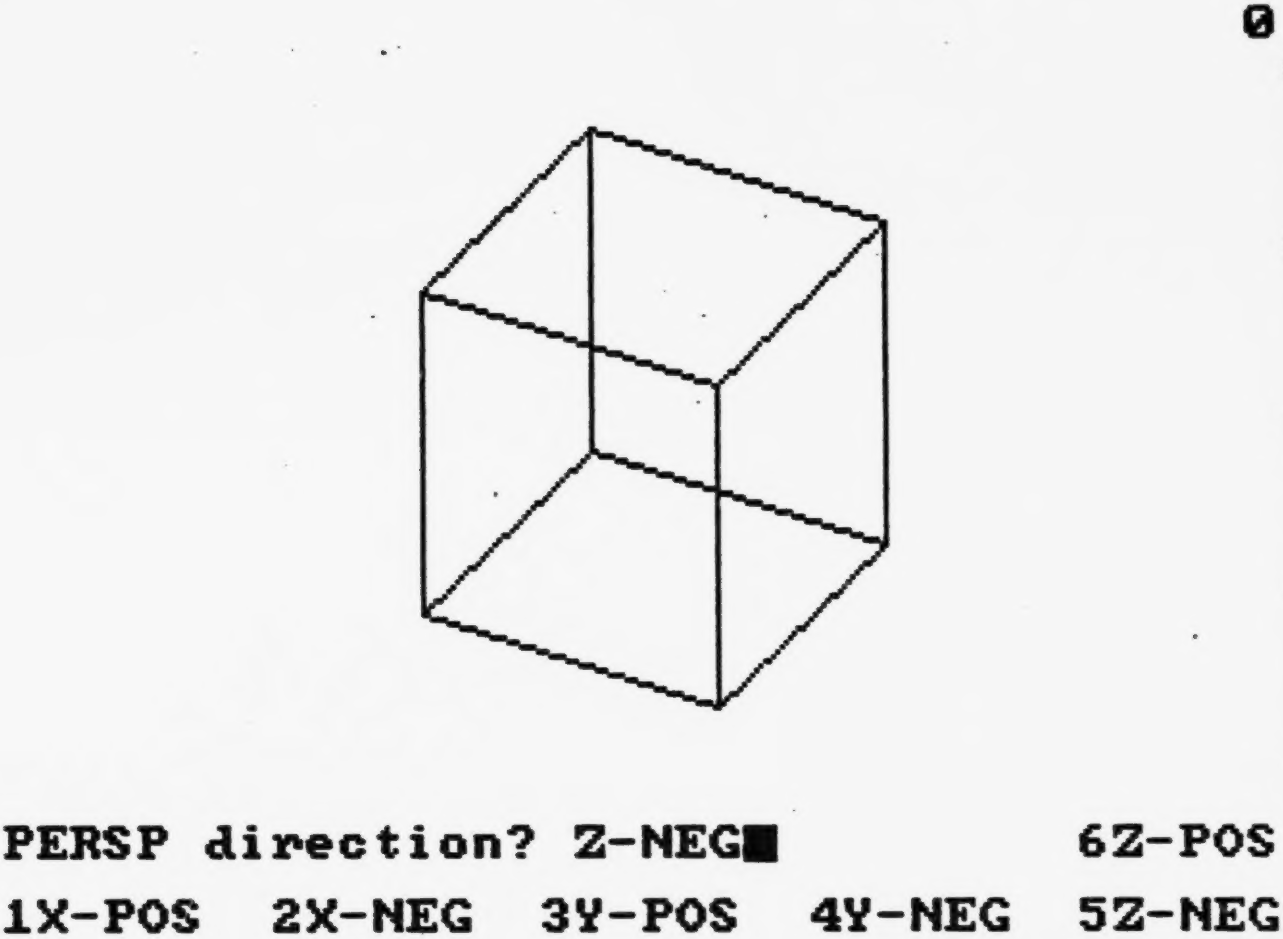


```
PERSP eye distance (+Z)? 5█
1   10    2 20      3 30      4 40      5INFIN
```

1



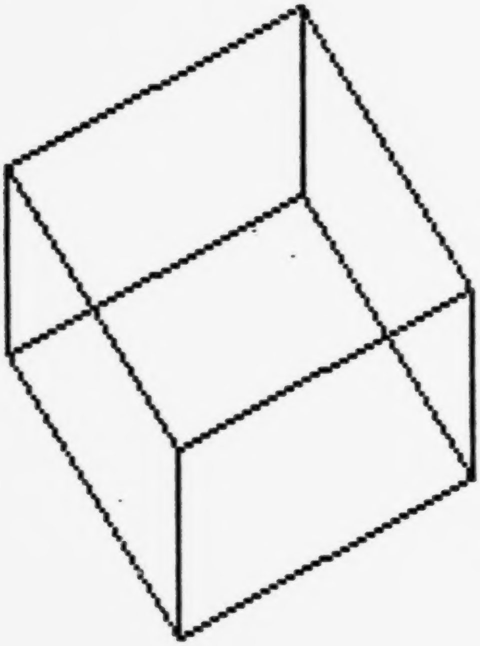
```
PERSP direction? Z-POS■                        6Z-POS
1X-POS   2X-NEG   3Y-POS   4Y-NEG   5Z-NEG
```



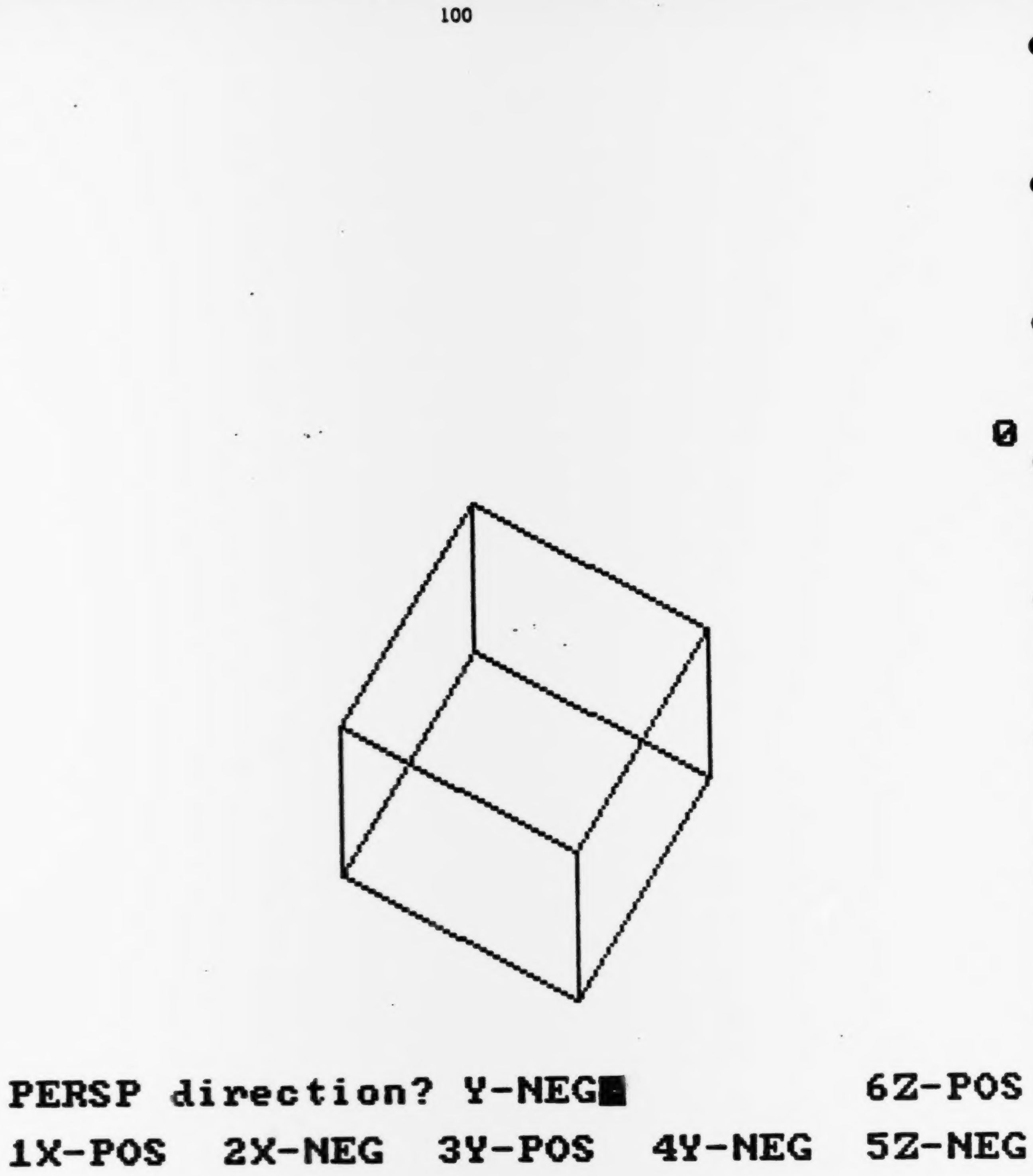
```
                                                   0

PERSP direction? Z-NEG█              6Z-POS
1X-POS   2X-NEG   3Y-POS   4Y-NEG   5Z-NEG
```

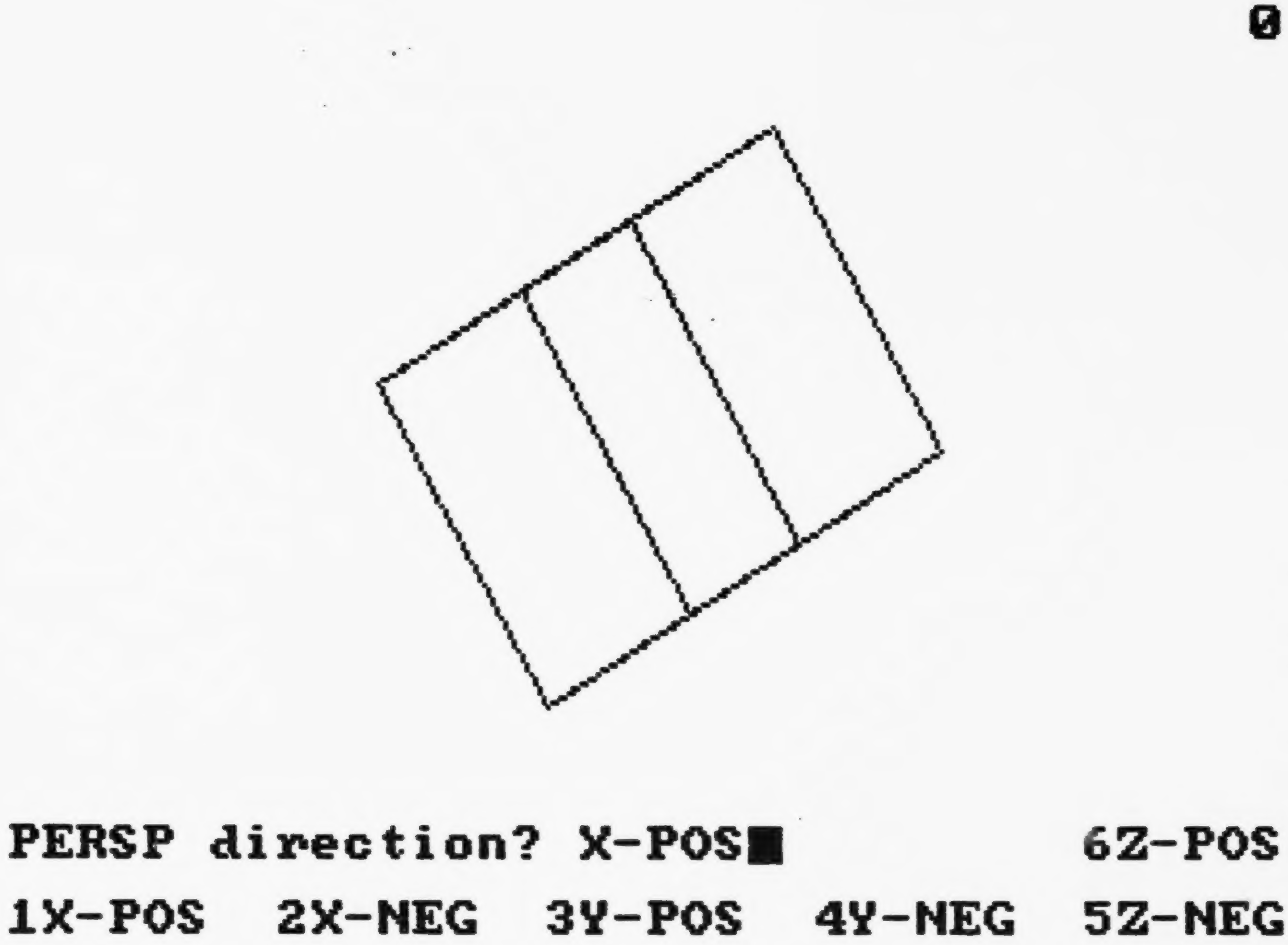
```
0
```



```
PERSP direction? Y-POS█          6Z-POS
1X-POS  2X-NEG  3Y-POS  4Y-NEG  5Z-NEG
```

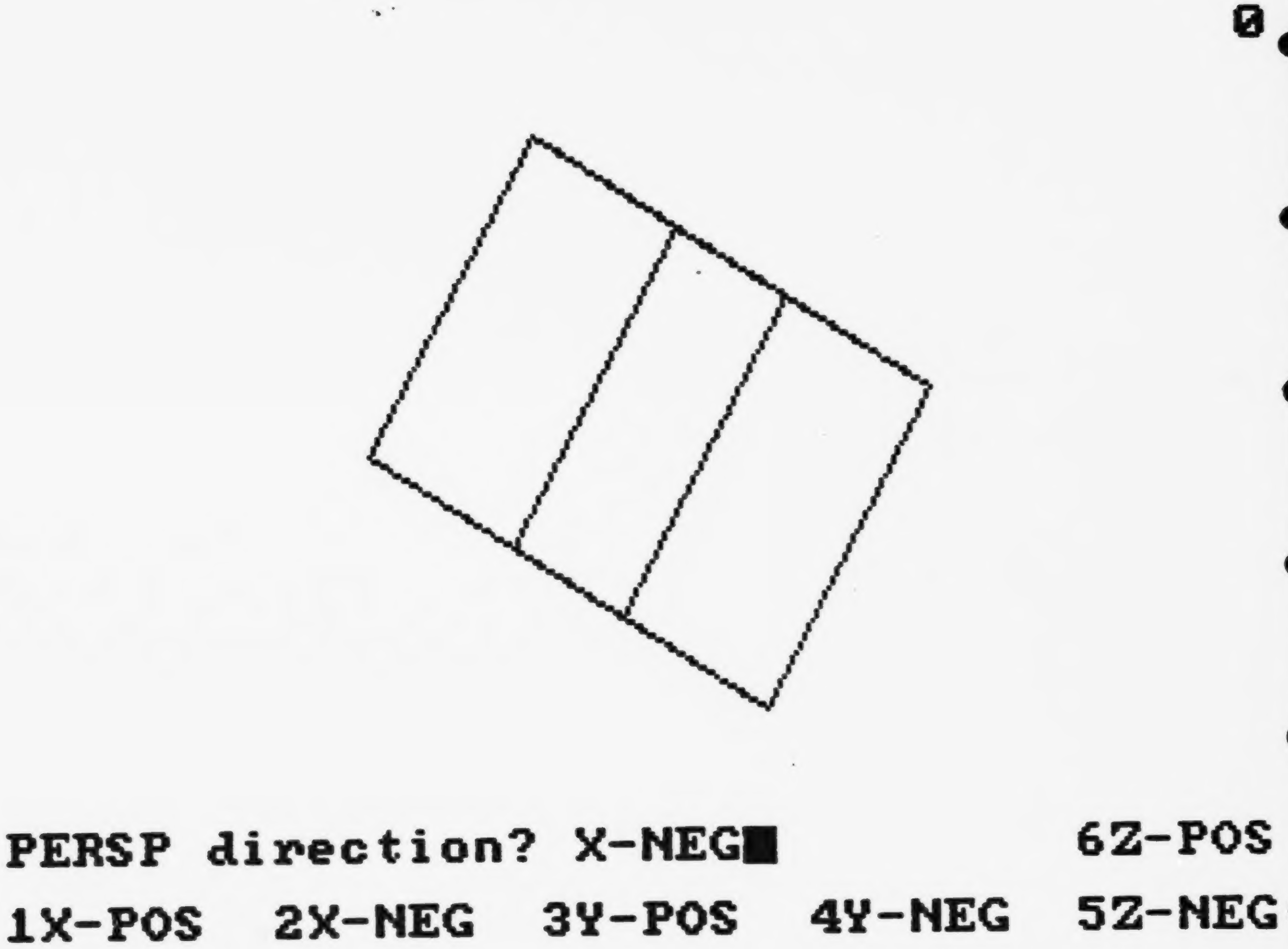


```
PERSP direction? Y-NEG█                 6Z-POS
1X-POS   2X-NEG   3Y-POS   4Y-NEG   5Z-NEG
```



```
                                                      0

PERSP direction? X-POS█                  6Z-POS
1X-POS  2X-NEG  3Y-POS  4Y-NEG  5Z-NEG
```

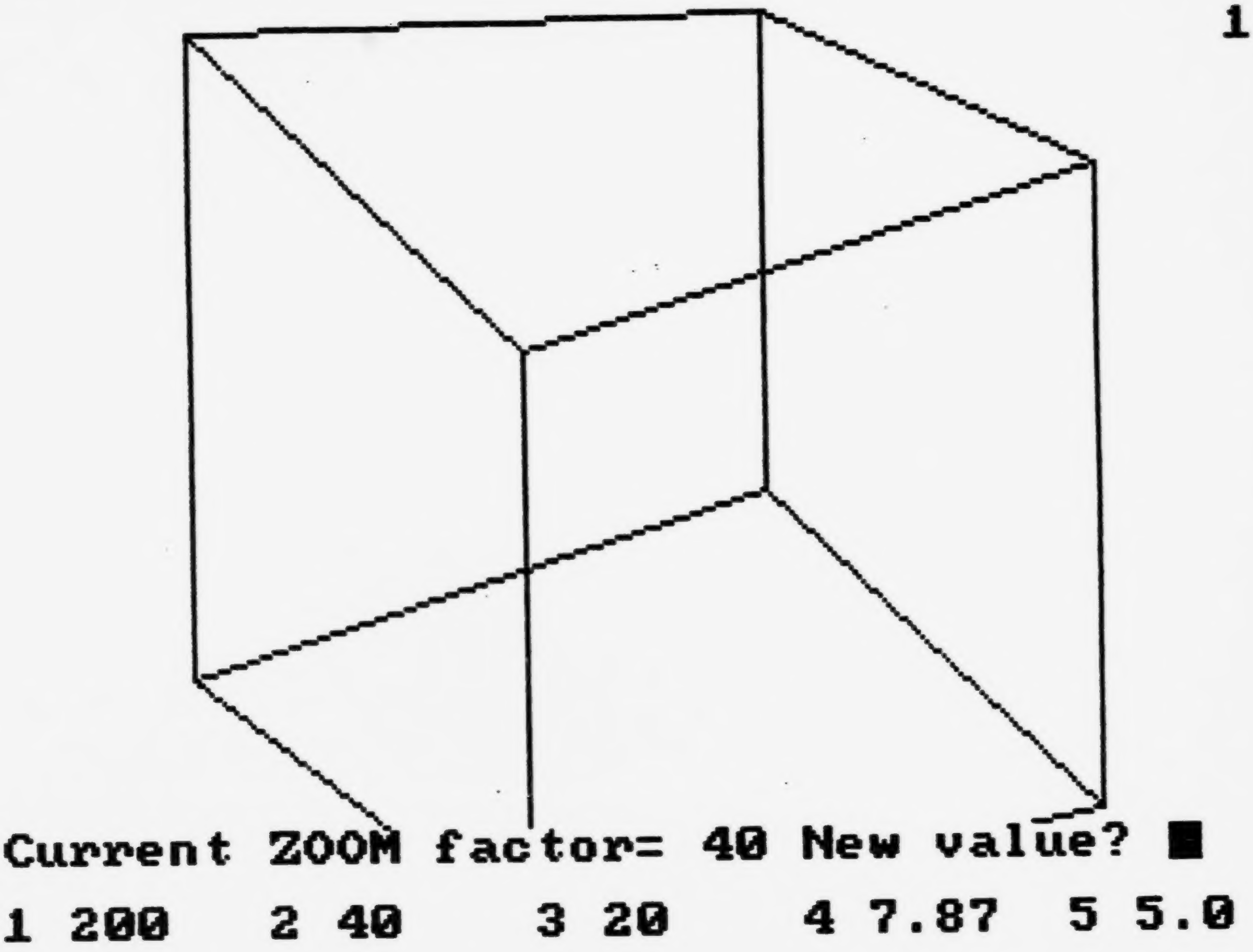


```
                                                      0

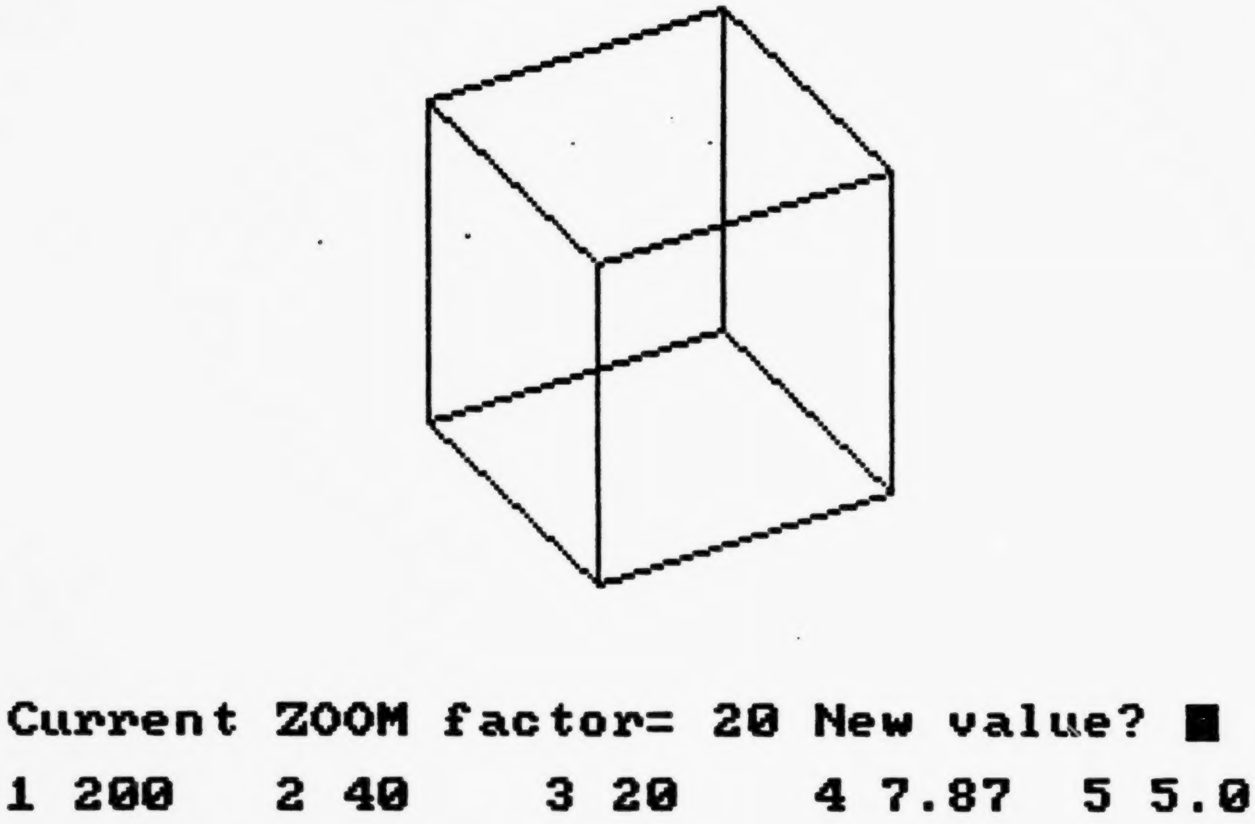


PERSP direction? X-NEG█              6Z-POS
1X-POS   2X-NEG   3Y-POS   4Y-NEG   5Z-NEG
```

1

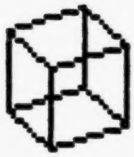


```
Current ZOOM factor= 40 New value? ■
1 200    2 40     3 20     4 7.87   5 5.0
```

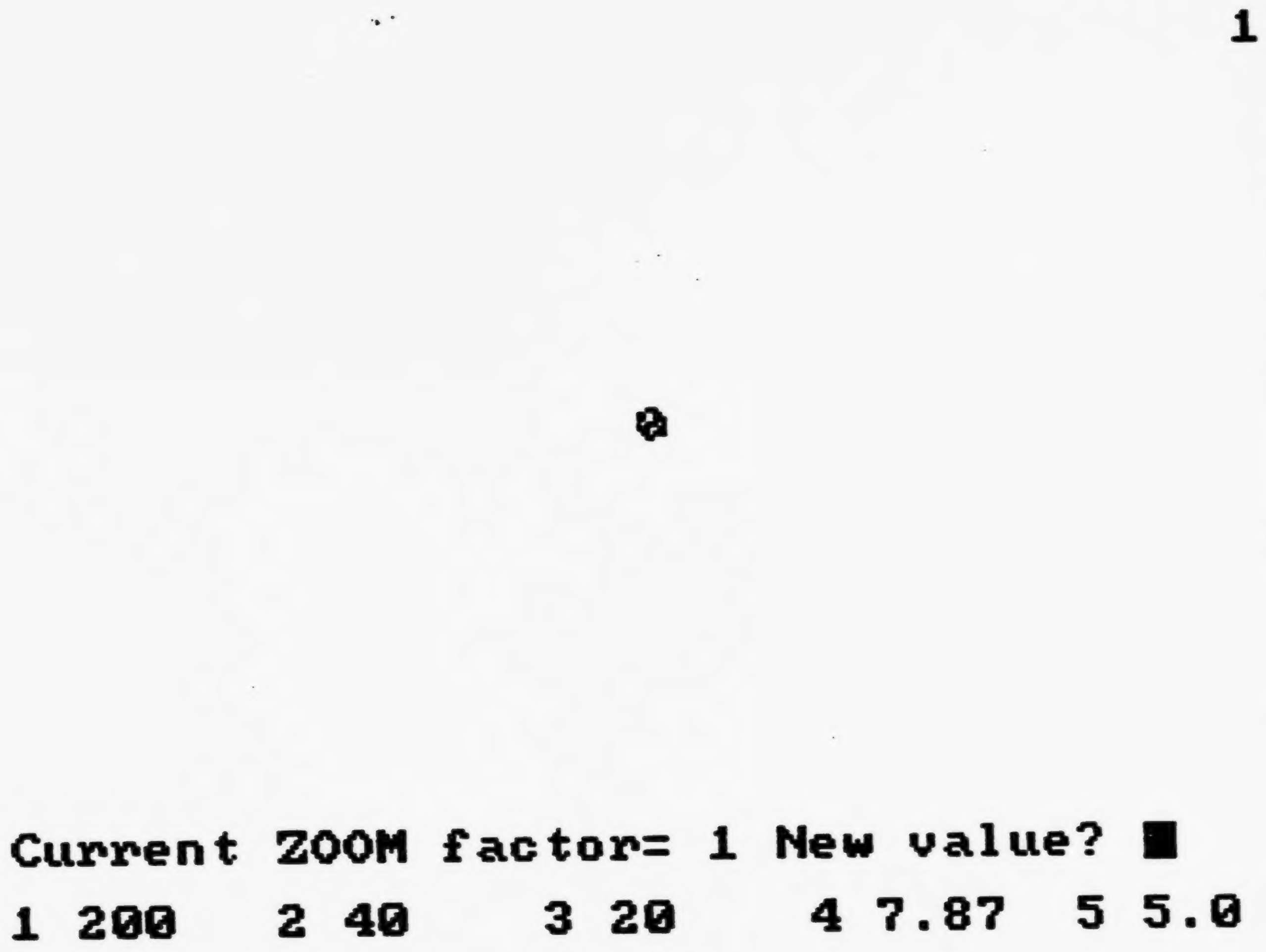


```
Current ZOOM factor= 20 New value? █
1 200    2 40    3 20    4 7.87   5 5.0
```

1

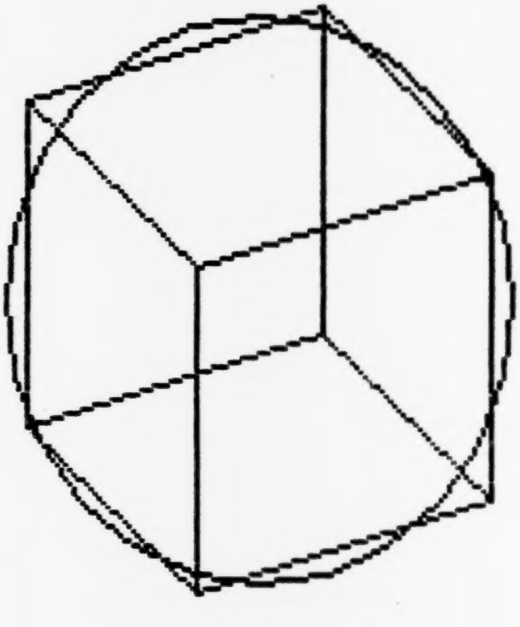


```
Current ZOOM factor= 5 New value? █
1 200   2 40    3 20    4 7.87  5 5.0
```



```
Current ZOOM factor= 1 New value? █
1 200    2 40     3 20      4 7.87   5 5.0
```

```
2
```



```
DISTANCE of X motion? ■
1  0.5  2   1.0 3  2.0  4  4.0  5  5.0
```

THE MAIN MENU

(1) T - FORM: (transformation)
(IN/OUT)

- rotation
- scaling
- movement (translation)
- plot 3 views
- perspective views
- zoom in/out

(2) FILES
(IN/OUT)

- load a file
- save a file
- list a file (coordinates in memory)
- choose active drawings- (in memory)
- directory- (in disk)
- erase a file - (in memory)
- edit drawing(s) - in memory (INGRAPH only)

(3) INPUT:
(IN only)

- create/modify drawings via:
  - space tablet
  - MCS 2-D tablet
  - keyboard
- set grid
- set USER scale for drawings
- create arcs, double images, mirror images

(4) OUTPUT:
(OUT only)

- make a hardcopy drawing(s) via:
  - EPSON dot matrix printer
  - HUSTON plotter

(5) **LABEL:**

(OUT only)

add texts

automatically dimensioning

change dimensions

load a LABEL file

save a LABEL file

(6) **EXIT:**

(IN/OUT)

exit to DOS system level

To change from:

INGRAPH	to	OUTGRAPH	selecting OUTPUT or LABEL (after OUTGRAPH disk is in)
OUTGRAPH	to	INGRAPH	selecting INPUT (after INGRAPH disk is in)

* During the change, any drawing in the memory will be erased.
(Make sure to SAVE the drawing and label it first)

ACTIVE DRAWING INDEXING

The number shown in the upper right corner of the screen will indicate the active status.

FUNCTION RESULT	INDEXING NUMBER
LOAD: loads file from disk	index of last drawing loaded
CHOOSE: INDEX makes a specific drawing active	index of choosen drawing
CHOOSE: ALL makes all drawings in memory active	0
ERASE: makes all remaining drawings active	0
UNIFY: makes all drawings into a single active drawing	0, 1
No drawing in memory	0

UNIVERSITY OF
NORTH DAKOTA
DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 8

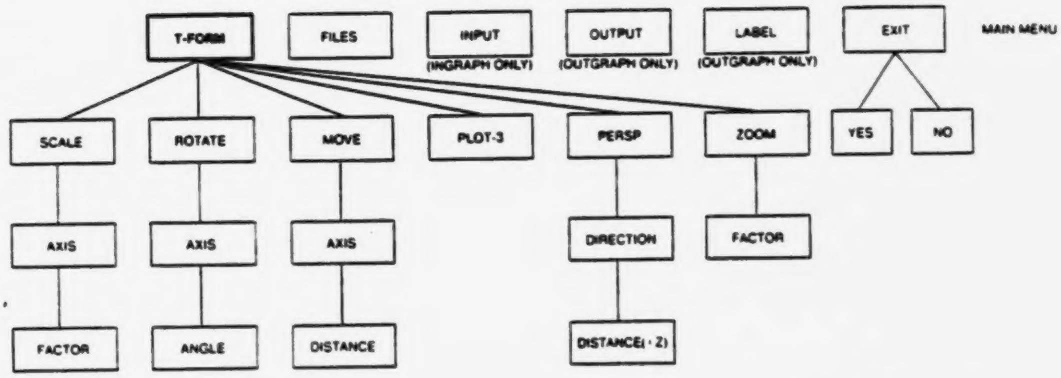
LAP TITLE: CADD Function - Transformation (T-Form)

PREREQUISITE LAP (S) : CADD 7

LAP PURPOSE: to master various graphic transformaton techniques which are contained in the Advanced Space Graphics system.

COMPETENCIES TO BE DEVELOPED:

1. To define the six transformation functions.
2. To explain how those six functions can be used and their applications.
3. To perform scaling, rotating, moving, zooming on existing drawings.
4. To present drawings to the orthographic projection and the perspective viewing forms.
5. To sketch out anticipated outcomes of a drawing after it was transformed.



Tree 1

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T - FORM : SCALE

1. Run INGRAPH to operational level
2. FILES——→LOAD : C3. GRA (A chair)
3. T-FORM

SCALE

a. X(2)
X(0.5)
X(1)

b. Y(2)
Y(0.5)
Y(1)

c. Z(2)
Z(0.5)
Z(1)

d. X(2)
Y(0.5)
Z(2.5)

e. X(0.5)
Y(2)
Z(0.4)

f. X(1)
Y(1)
Z(1)

g. ALL (2)
ALL (0.5)
ALL (1)

*SCALE means increasing or decreasing each of its USER coordinates along all axis (X, Y, Z) or individually.

*ALL three axis can be scaled by the smae factor or different factors.

*The default scale value is 1.
2 means double the USER coordinate
1/2 or 0.5 means 1/2 the USER coordinate

USER = TABLET * T-SCLA
If tablet = 1 inch, USER = wt
Select T - Scale = 2
The USER = 2 units

*SCALE factor 1 will not change the size but will center the drawing.

*SCALE will change the USER coordinate values in the memory. Therefore, the drawing is changed.

* Relative transformation.

T-FORM: ROTATE

1. T - FORM

ROTATE:

a. X(30°)	b. X(10°)	c. Z(-10°)	d. Z(-30°)
Y(30°)	Y(10°)	Y(-10°)	Y(-30°)
Z(30°)	Z(10°)	X(-10°)	X(-30°)

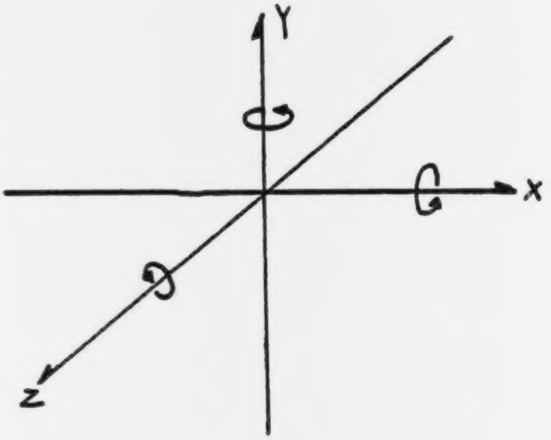
e. SCALE All (0.7)

ROTATE

X(300°)

Y(60°)

Z (20°)



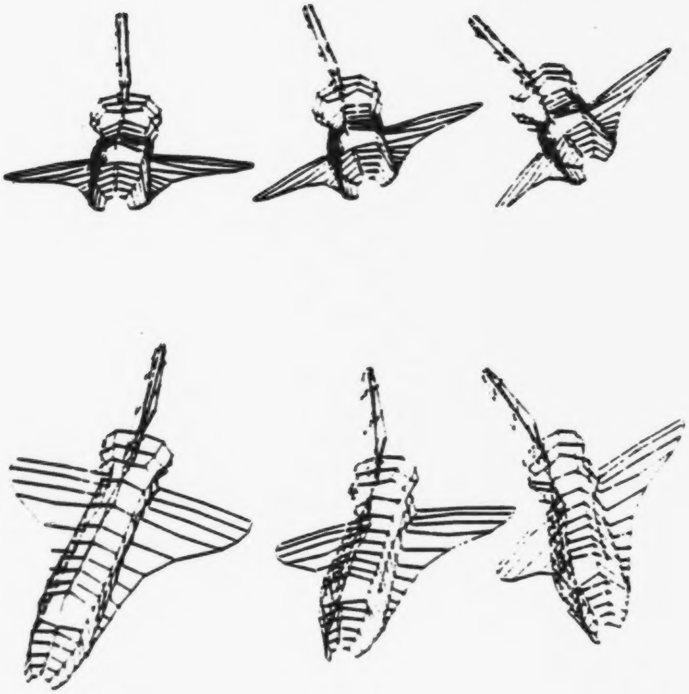
* Always based on the current drawings in terms of rotation

X (+30°) ⟶

⟵ X(-30°)

$$* \quad \left.\begin{matrix} X(+30^\circ)\\ \downarrow\\ Y(+30^\circ)\\ \downarrow\\ Z(+30^\circ)\end{matrix}\right] \longrightarrow \left[\begin{matrix} X(+10^\circ)\\ \downarrow\\ Y(+10^\circ)\\ \downarrow\\ Z(+10^\circ)\end{matrix}\right. \neq \left[\begin{matrix} X(-40^\circ)\\ \downarrow\\ Y(-40^\circ)\\ \downarrow\\ Z(-40^\circ)\end{matrix}\right.$$

* Relative transformation



A series of ROTATions of a drawing of the Space Shuttle digitized with the SPACE TABLET™

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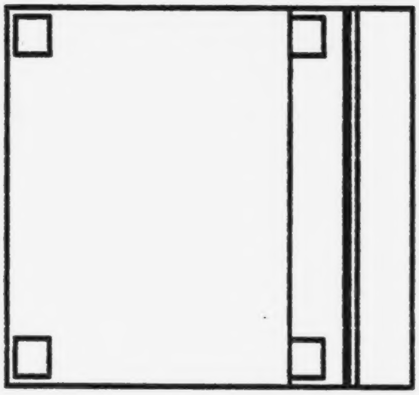
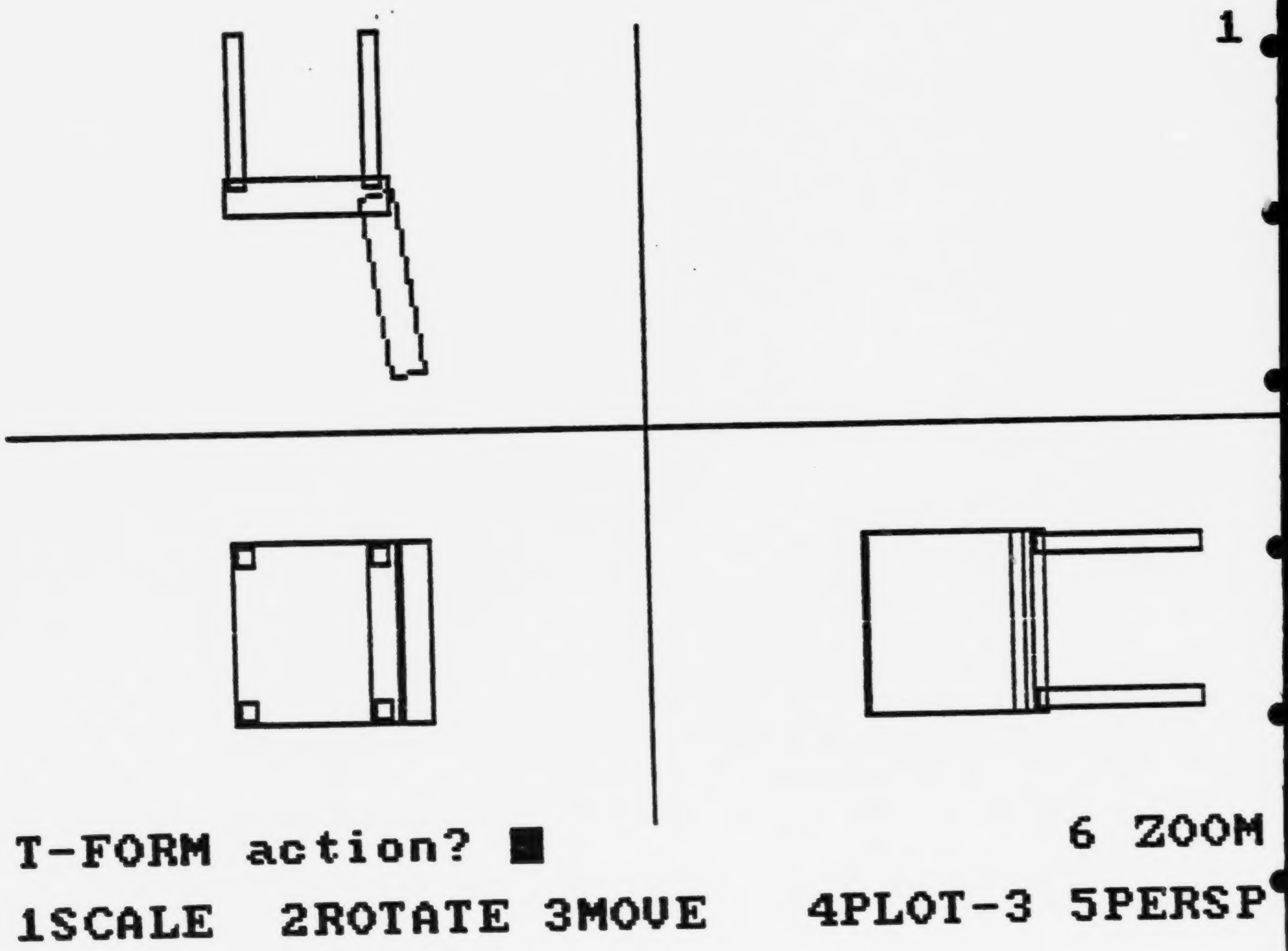
                                                   1
```

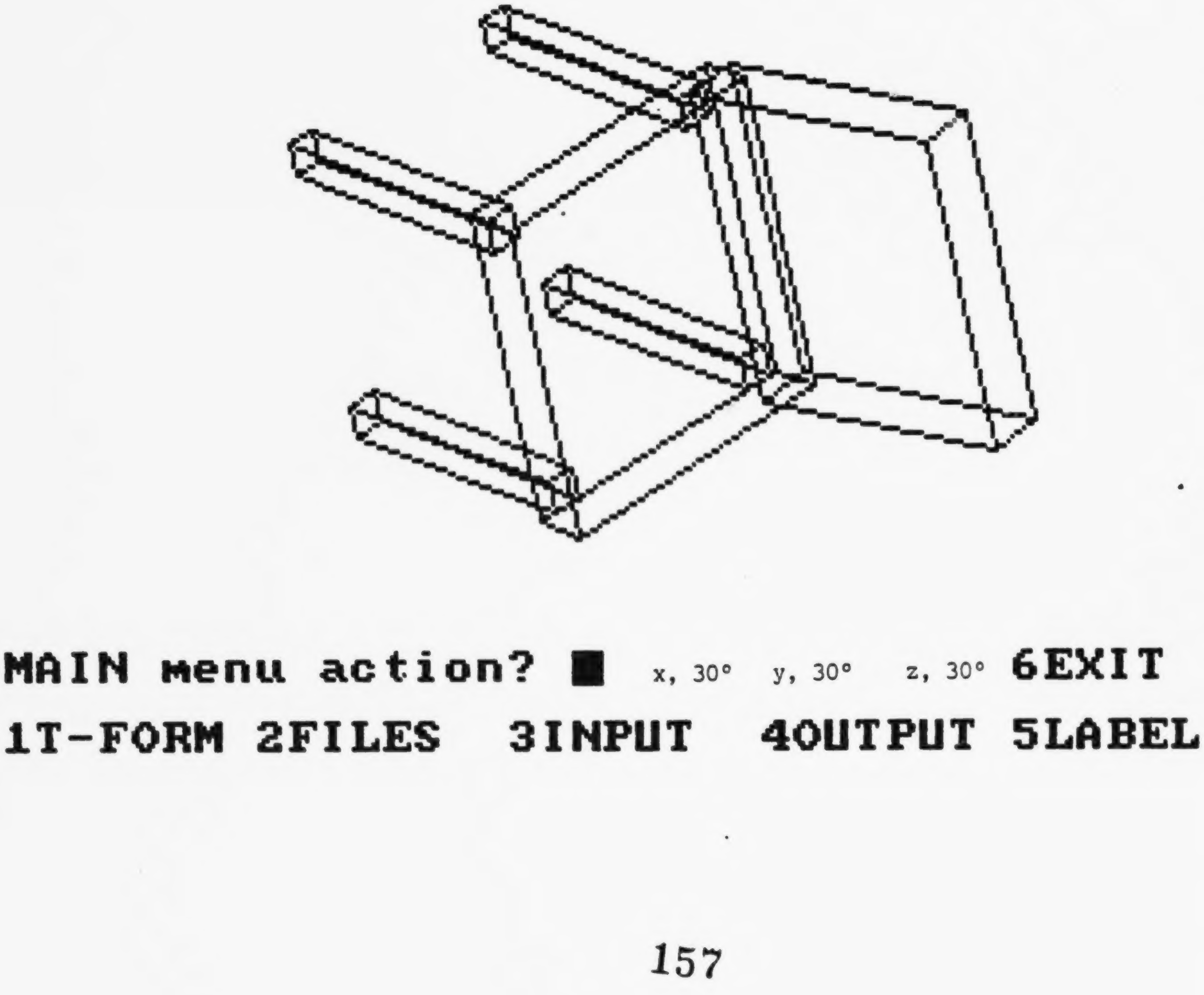


```
T-FORM action? █                          6 ZOOM
1SCALE  2ROTATE 3MOVE   4PLOT-3 5PERSP
```

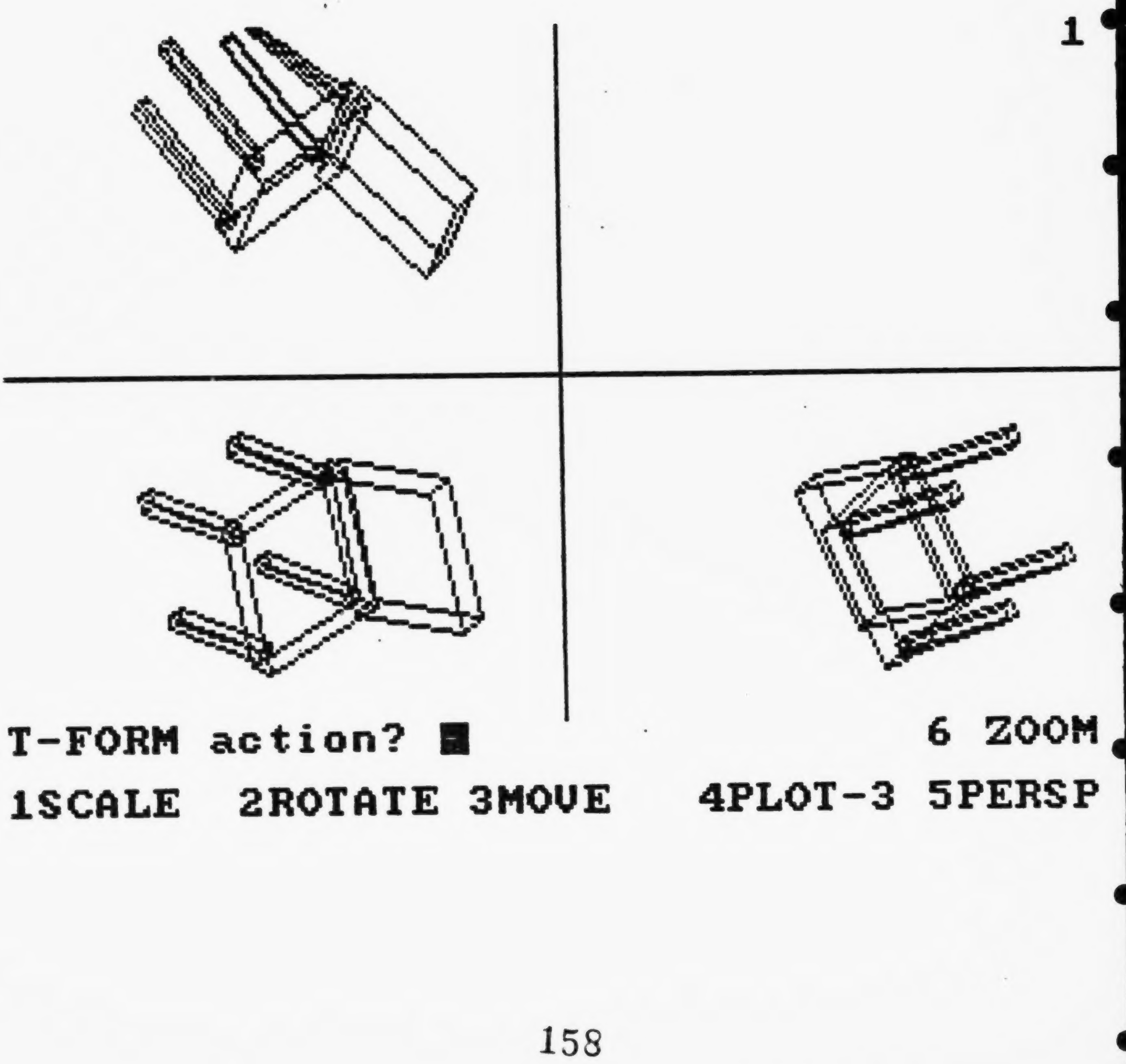


```
T-FORM action? ■                                  6 ZOOM
1SCALE  2ROTATE 3MOVE   4PLOT-3 5PERSP
```

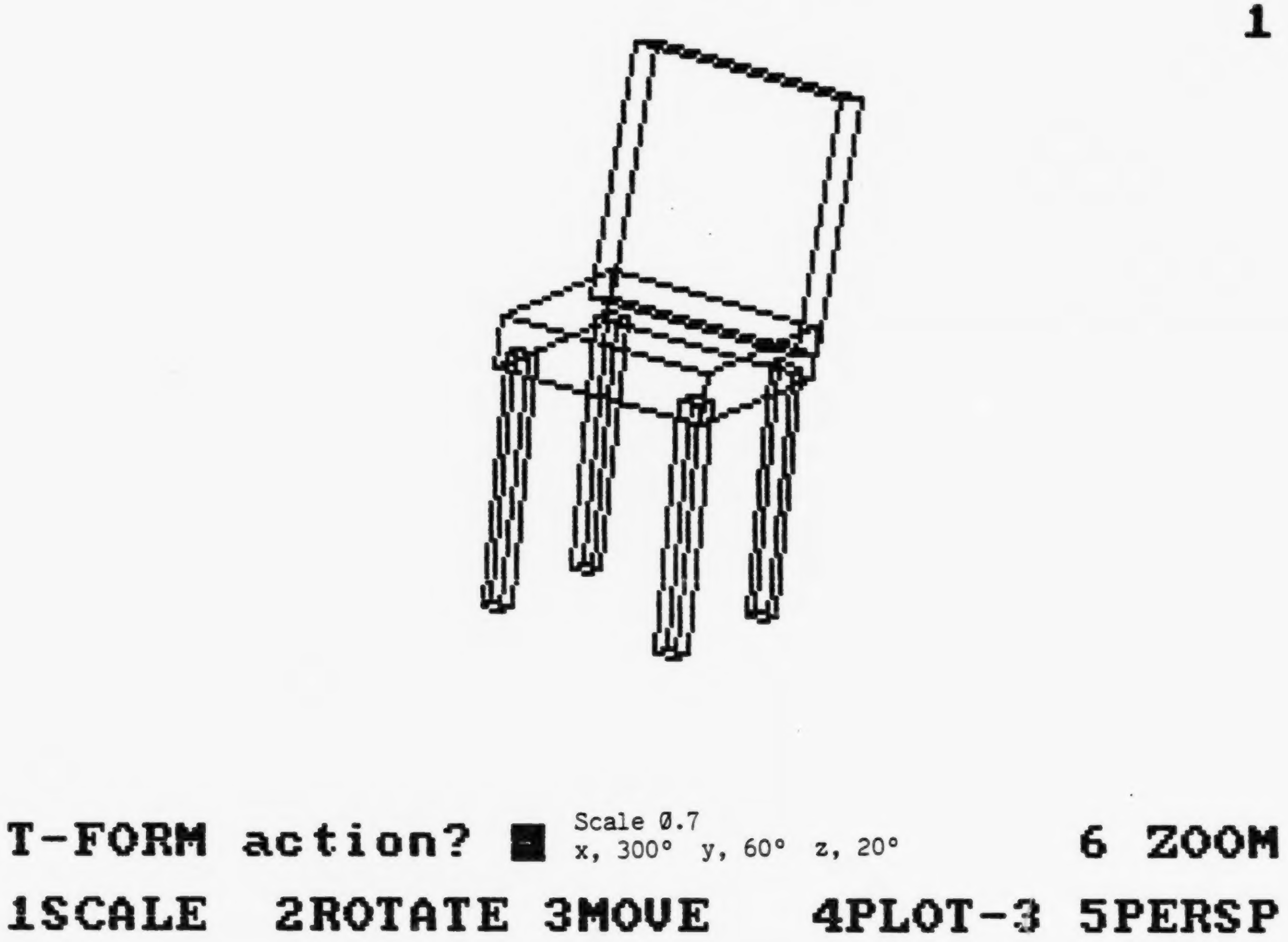
1



```
MAIN menu action? █  x, 30°   y, 30°   z, 30° 6EXIT
1T-FORM 2FILES  3INPUT  4OUTPUT 5LABEL
```

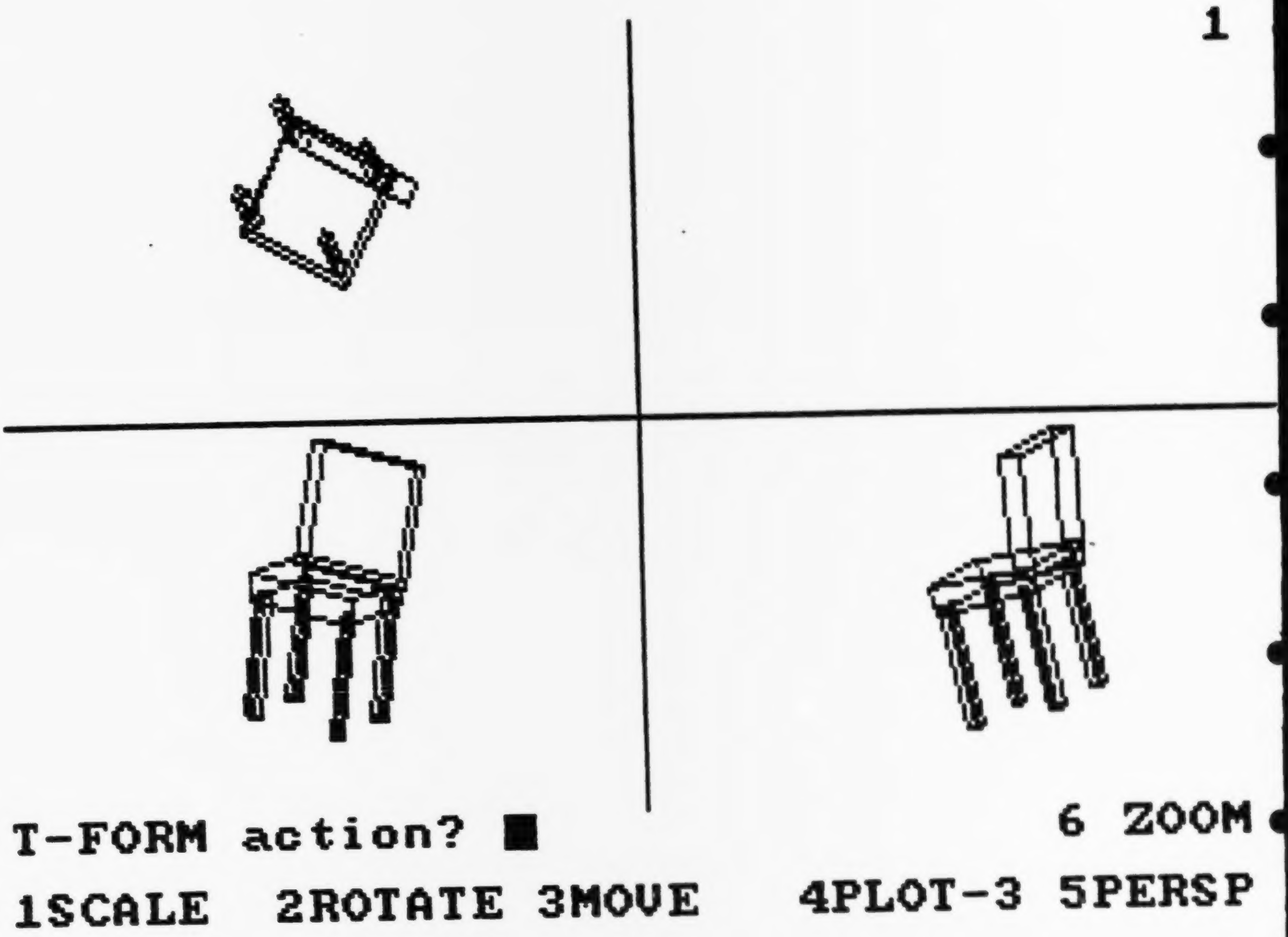


T-FORM action?



T-FORM action?

Scale 0.7
x, 300° y, 60° z, 20°



```
T-FORM action? ■                          6 ZOOM
1SCALE  2ROTATE 3MOVE   4PLOT-3 5PERSP
```

T-FORM : MOVE

1. T-FORM

MOVE	a. X(4)	b. Y(4)	c. Z(4)
	X(-2)	Y(-2)	Z(-2)
	X(-2)	Y(-2)	Z(-2)

* For Z axis move:

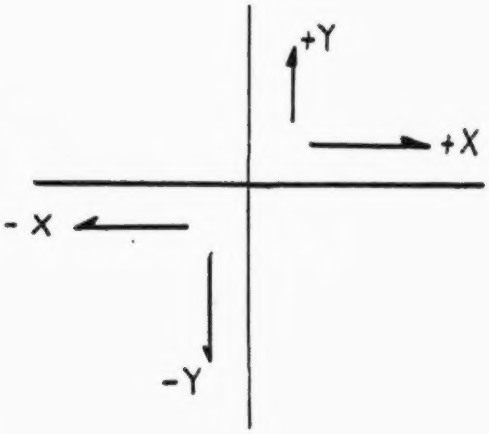
(a) no visual change

(b) the Z axis coordinates changed

* The distance of MOVE is based on the USER coordination

* If you move too far on X, Y (out of the screen capibility limit) a distorted view will be displayed.

* Relative transformation



T-FORM : PLOT -3

1. T-FORM

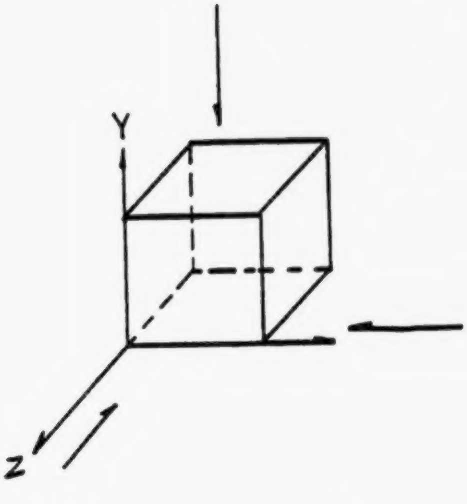
PLOT -3

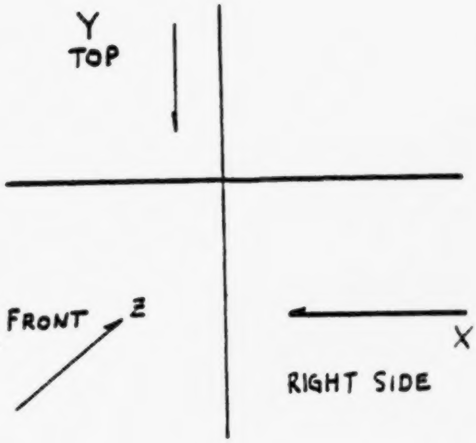
* Three orthogonal projections of the drawing(s) in the memory are simultaneously plotted on the screen.

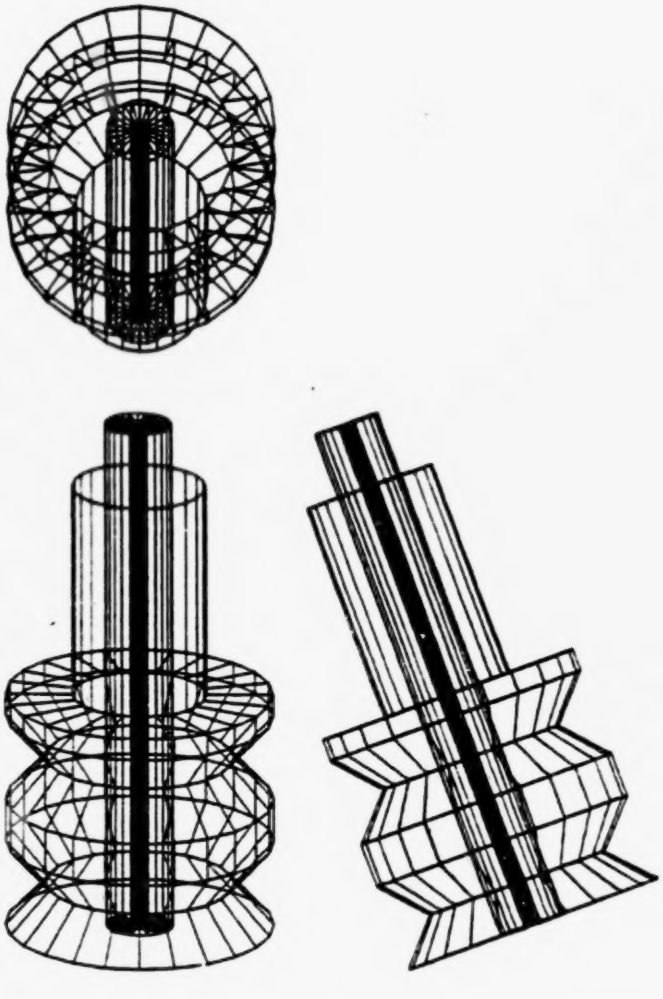
* The views are from

the X - positive axis
Y - positive axis
Z - positive axis

* The 3 views are based on current drawing(s) on the screen. (The intial view of the drawing is the view from the Z positive axis)







Three orthogonal views of a pulley obtained (using the PLOT-3 function) by pressing a single key.

T - FORM : PERSP

1. T-FORM

   PERSP

a. X - POS

   X - NEG

b. Y - POS

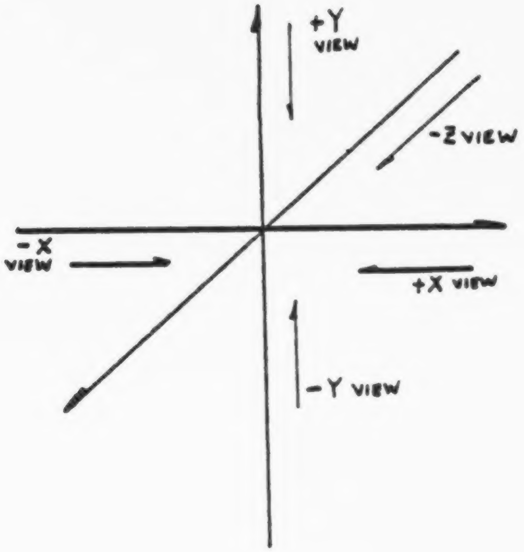
   Y - NEG

c. Z - POS(5)

   Z - POS (10)

   Z - POS (INFIN)

   Z - NEG



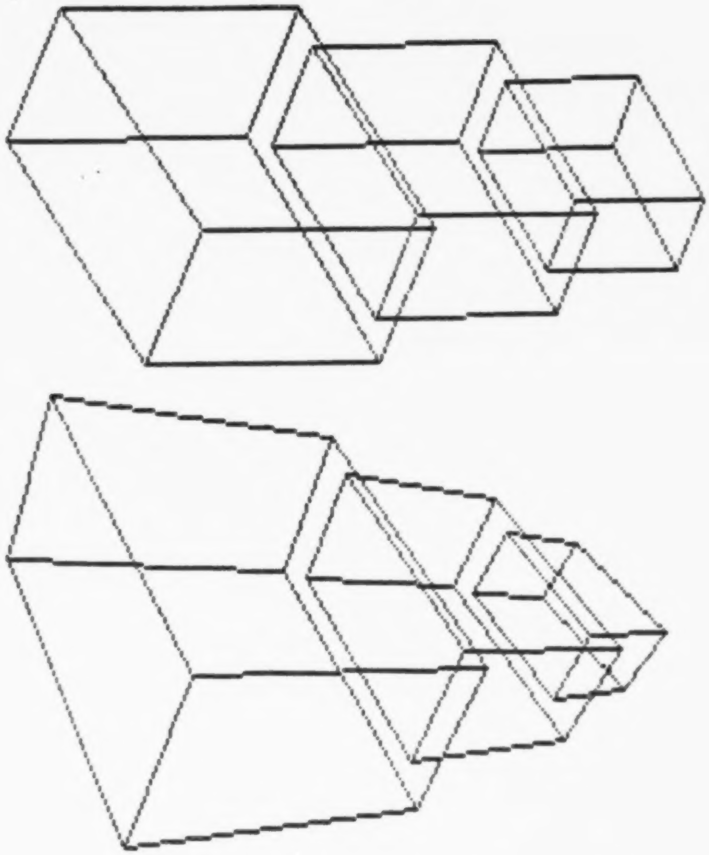
d. Z - POS(5)

   X - POS

e. Y - POS

f. Z - POS (INFIN)

- * Single point perspectives can be obtained by choosing the Z - POSITIVE with small or medium range of the eye distance.
- * Eye distance is based on the USER coordinates at X 0, Y 0, Z USER.
- * The closer between eye and the object (eye distance) the greater the convergence. (INFIN will give non-converging result)
- * After Z POS PERSP, other T-FORM functions will keep the converging effect.
- * The software will not perform extreme close-up "fish-eye" perspectives properly.



Top: A composite of individual boxes viewed from an effectively infinite distance. Parallel lines do not appear to converge in the distance. Bottom: The same composite viewed from a distance of 20 USER coordinates. Parallel lines converge in the distance.
Both drawings were printed on an MX-80 dot matrix printer.

T - FORM : ZOOM

1. T-FORM

ZOOM

a. 60	b. 10
40	5
20	2
	20

* The default value is 20
It means 1 USER unit will take 20 screen pixels.

ZOOM 40 means enlarging the drawing twice the size as the original on the screen.

* The ZOOM function doesn't change values of USER coordinates in the memory.

It shows the enlarged or reduced visual effect only.

* Positive whole numbers or decimals can be used as a ZOOM factor.

* ZOOM will not change labeled dimension values.

* ZOOM factor selection should consider the T-SCALE.

USER = TABLET * T—SCALE

SCREEN = USER * ZOOM

SCREEN = TABLET * T—SCALE * ZOOM

* ABS. transformation

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HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 9

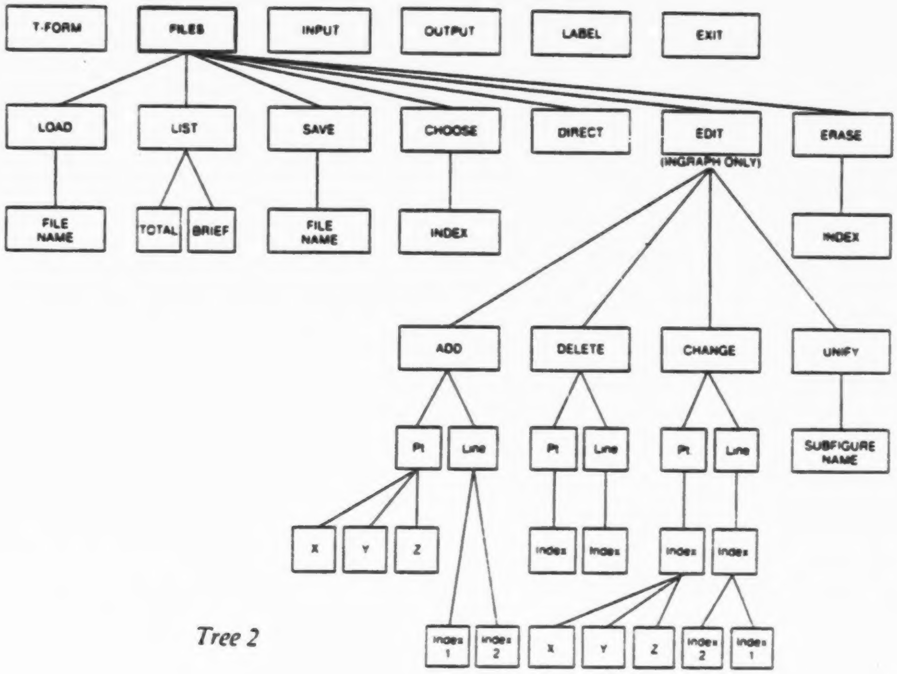
LAP TITLE: CADD function - File Handling and Editing (FILES)

PREREQUISITE LAP (S) : CADD 8

LAP PURPOSE: To master file management and graphic editing techniques.

COMPETENCIES TO BE DEVELOPED:

1. To save a drawing onto a data disk.
2. To load a drawing from a data disk.
3. To list a complete or brief geometric data file.
4. To correct, modify or delete graphic elements when they are needed.



Tree 2

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FILES : LOAD

1. <u>FILES</u>

    <u>LOAD</u> · Cl. GRA

- * FILES must be existing on the disk currently in the drive.
- * ALL files should be loaded from data disks except those manufactur provided sample drawings.
- * Several files can be loaded in the memory. (Parts or components of a drawing)
- * Only the last file loaded in the memory is an active drawing unless the CHOOSE function is used to modify it.

FILES : LIST

1. <u>FILES</u>

    <u>LIST</u> a. <u>BRIEF</u>

    b. <u>TOTAL</u> CTRL + NUM LOCK will pause the scrolling

```
*BRIEF:  Number of drawing
         Drawing index # 1 Name:     number of pts.
         Drawing index #2  Name:     number of pts.
         :                               "
         :
         Number of lines=                "

TOTAL:   Number of drawing
         Drawing index #1  Name:     number of pts.
         Pt: 1 X=    Y =     Z=
         Pt: 2 X=    Y =     Z=
         :           :       :
         :           :       .
         Number of lines
```

	Points connected	
line index #1	1	2
2	2	6
.	.	.
.	.	.
.	.	.

Drawing index #2	Name		Number of pts.
pt.	X=	Y=	Z=
pt.	X=	Y=	Z=
.	.	.	.
.	.	.	.
.	.	.	.
Number of lines			

* There are three kinds of index systems

a. Drawing Index: assigned based on the sequence of files (drawings) loaded in.

b. Line Index : shows the point index numbers of a line connected.

c. Point Index: shows the X, Y, Z USER coordinates of a point.

FILES : CHOOSE

1. FILES

   CHOOSE (1) —— #1 drawing

   CHOOSE (2) —— #2 drawing

   CHOOSE ALL

note: you can not choose 2 or more active drawings (either one or ALL)

* Number entered stands for drawing index number.

* CHOOSE makes selected drawings to be active for other functions.

* On color monitor the active drawings are colored white, the non- active drawings are violet in color.

FILES : DIRECT

1. FILES

   DIRECT

   * Directory
   * Equivalent to the DOS system command DIR.

** PLEASE ERASE ALL CURRENT DRAWING(s) BY USING: FILE → ERASE → ALL functions at this point.

FILES : EDIT (ADD, DELETE, CHANGE, UNIFY)

1. LOAD : C2. GRA (a cube)

2. EDIT ----→ADD -------→POINT X, Y, Z, ; X, Y, Z

2, 3, 1 4, 4, 4

LINE---→pt. index of end points of the line

pt.8---→pt. 9 (line #13) (note : after the action the drawing will disappear)

pt.9---→pt. 10 (line #14)

3. DELETE-----→LINE (line index of the point) (line #14)

(you delete the line, the pt. is still there)

POINT (point index of the line) (pt. #10)

F-10 (after you finish the delete, press F10 instead of enter)

4. CHANGE -----→POINT pt. index of the line

9

New coordinate value:

X, Y, Z

3, 4, 5

LINE LINE line index of the line

check the list

new pt. index of the end points

9-------→1 (The original pt. 8 to pt. 9 line will no longer be there, instead a new line of pt. 9 to pt. 1 is created).

5. LOAD : C1. GRA (a circle)

6. UNIFY: new name of the unified figure

UNIDRW

(no need to CHOOSE ALL)

* After DELETE a point or line, pt. index or line index will be changed.

* UNIFY will make all subdrawings to one drawing and make all to active (similiar to CHOOSE ALL). However, UNIFY will lose the individual identity, therefore,no CHOOSE can function after it.

** PLEASE ERASE ALL CURRENT DRAWING(s) BY USING FILE → ERASE → ALL functions at this point.

FILES : ERASE

1. LOAD: C3.GRA (A Chair)

2. LOAD: C2. GRA

3. ERASE: drawing index?

(1)

or (2) (once you erase the #1 drawing then the original #2 drawing will become the #1 drawing in index #)

or (ALL) (A lower # index drawing is erased, then the next higher # index drawing will move to the lower # index Every other drawing will more, too.

* ERASE will erase a drawing from the memory.

* If you store (SAVE) the drawing on the DISK before, the ERASE will not delete the file on the disk.

* To delete a drawing file on a data disk)

CTRL + ALT + DEL------>A<

then

E R A S E file_name with_extension_

* Athough you only erase one file, all other files in the memory are becoming active (the corner should be 0)

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Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 10

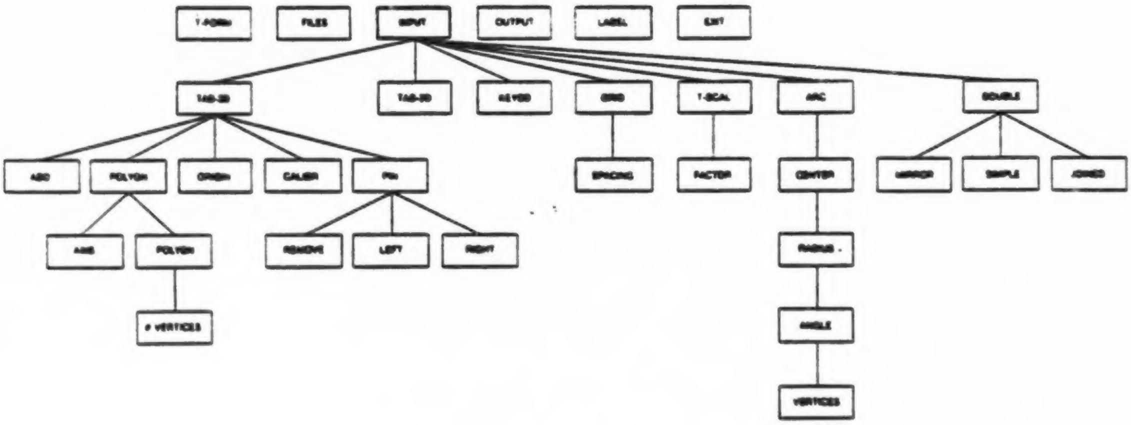
LAP TITLE: CADD function - Input Methods (INPUT)

PREREQUISITE LAP (S) : CADD 9

LAP PURPOSE: to create or modify a drawing via three available input methods.

COMPETENCIES TO BE DEVELOPED:

1. To determine and select the appropriate scale for a given object.
2. To select the most efficient input method or the best combinations for the desired drawing construction.
3. To operate all three input methods effectively.
4. To use the polygon, arc and the double functions effectively.



Tree 3

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INPUT : TAB - 3D (Add, Polygn, Origin, Calibr, Pin)

All 3D Space Tablet digiting must be done after the tablet has been calibrated.

1. INPUT ---→ TAB 3-D ---→ PIN ---→(LEFT)
   PIN-----→(REMOVE)

2. INPUT -----→ADD -----→(CURS. C)
   1

+ passive cursor   -¦- active cursor

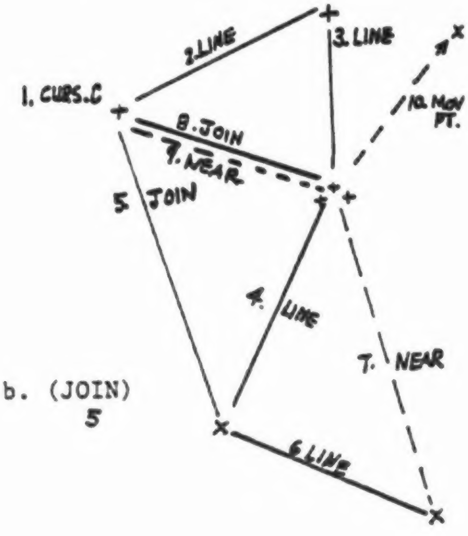
+ ———→ -¦- cursor combine

+ two cursors overlap at the same point

*When starting a drawing, combine two cursors

*Enable to draw non-successive connecting lines

a. (LINE)-----→(LINE)------→(LINE)
   2 3 4



* LINE will move passive cursor to the the active cursor's position.

* Successive connecting lines can be drawn.

b. (JOIN)
   5

* JOIN command draws a line between the passive cursor and the point nearest to position of the active cursor.

** The PASSIVE cursor retains its original position. (not moving to the position of the active position)

c. (LINE)
6

d. (NEAR)
7

* NEAR moves the passive cursor to a previously digitized point nearest to the position of the active cursor.

e. (JOIN)
8

f. (NEAR)
9

g. (DELETE)
(DO NOT TRY THIS FUNCTION AT THIS STAGE)

* Erase the point at which the passive cursor is located.

* Use the NEAR function to move the passive cursor to the unwanted point, and DELETE it.

* All lines connected to the deleted point will be deleted.

h. (MOV. PT)
10

* Move an existing point to desired locati

* Use NEAR to move the passive cursor to a desired existing point, locate the active cursor to a desired location. (See the rubber band effect)

i. (FG. MOVE) figure move

* Positioning the passive cursor on a point of the drawing to be moved. (NEAR)

* Move the active cursor to a desired locat

j. ADD--------(X) (freeze X axis)
(X) (try to move the pointer)
(unfreeze X axis)

* Freeze X axis while adding

* Y, Z axis can be done the same way

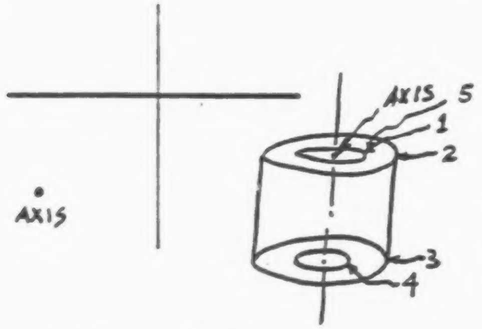
3. FILES---------ERASE (ALL)

INPUT -------TAB 3D

POLYGN -----(AXIS) (find an axis) (SPACE BAR)

(use hollow cylinder model)

number of verticis (20 or more will make the polygn to a circle)



(20)

(move the pointer) (SPACE BAR) (pt. 1)

(move the pointer again) (SPACE BAR) (pt. 2)

(move the pointer again) (SPACE BAR) (pt. 3)

(move the pointer again) (SPACE BAR) (pt. 4)

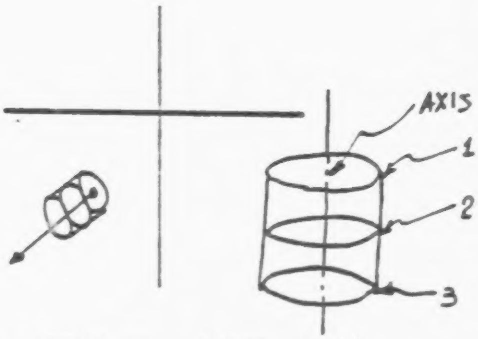
(move the pointer again) (SPACE BAR) (pt. 5)

Play Doh

POLYGN -------(AXIS) (find an axis) (SPACE BAR)

number of verticis

(30)



(move the pointer) (SPACE BAR) (pt. 1)

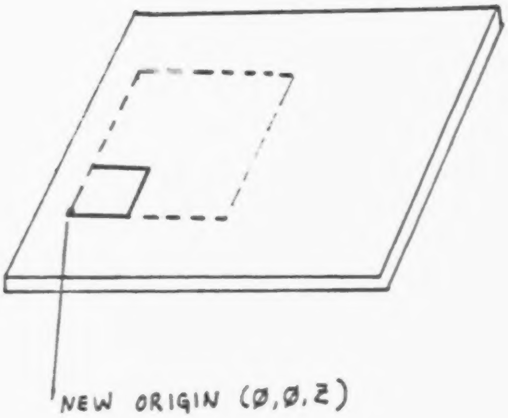
(move the pointer) (SPACE BAR) (pt. 2)

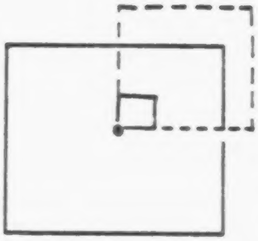
(move the pointer) (SPACE BAR) (pt. 3)

4. FILES------ERASE (ALL)

INPUT------TAB 3D

ORIGIN (move the pointer) (SPACE BAR)





* The origin of the space can be set at a desired position.

* The coordinates of that position will be O(0,0,Z)

* The origin on the screen is fixed at the center of the screen.

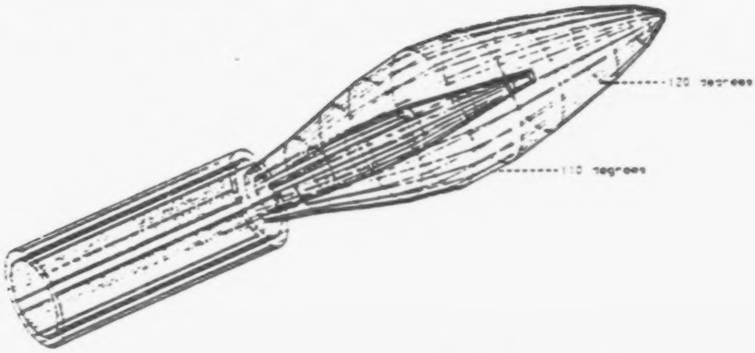
* The origin set with this function is not remembered by the program when the ADVANCED SPACED GRAPHICS is exited.

5. TAB 3D insert the UTILITIES disk → CALIBR

* This is for calibrating the Space Tablet.

* If the calibration has been done, and no strange result happened during the digitizing, recalibration is not needed.

* Use the UTILITIES disk to run the calibration. Record (SAVE) calibration data on INGRAPH disk.



Isotherms of a hair dryer obtained by attaching a thermocouple to the SPACE TABLET™'s pointer, moving the pointer through the hair dryer's path, and using the POLYGN function.

6. TAB 3D · · · ·➤ PIN

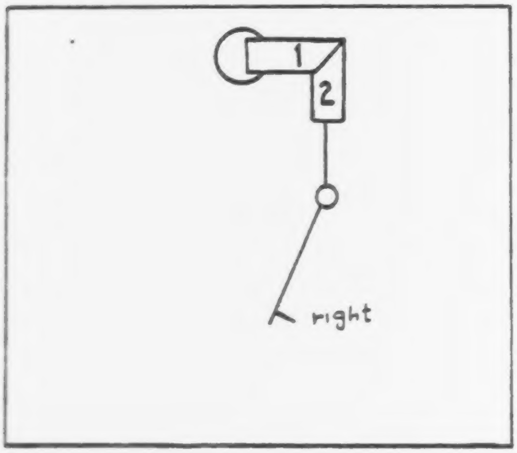
(LEFT)

(RIGHT)

(REMOVE)

* Whenever the crosspin is needed for digitizing, insert direction of the pin must be given.

* Default is (REMOVE)



INPUT : MCS 2-D TABLET

* X = 2 . Y = 1 DIST = 5

active cursor position

1

distance between the passive and active cursors

(USER coordinates)

* The screen functions are operated the same as those under TAB - 3D, ADD.

LINE, MOVE. PT , CURS. C , NEAR, JOIN, DELETE, FG. MOV

* The drawing will always be viewed form the +Z direction. (no Z value presented). (One view - FRONT VIEW)

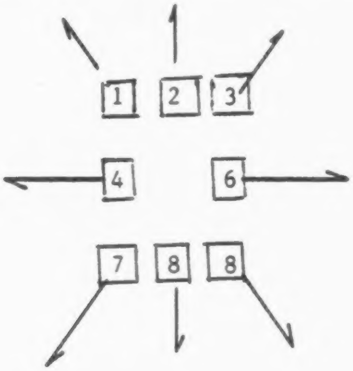
1. INPUT-------→GRID (1.0)

2. INPUT-------→TAB - 2D

INPUT : KEY BD

Keyboard input by:(1) cursor movement(must have a drawing in the memory or create a point first). (2) numerical data.

Cursor Movement: (The following keys are located at number pad.)



* Press the number key down, the cursor will keep moving until you release it.

* TAB ,upper case TAB give a larger distance curse moving right to left.

Fixing the PASSIVE cursor and ACTIVE cursor:

SPACE BAR

blinking cross (new active cursor position)

passive cursor at reference point (center)

Drawing functions:

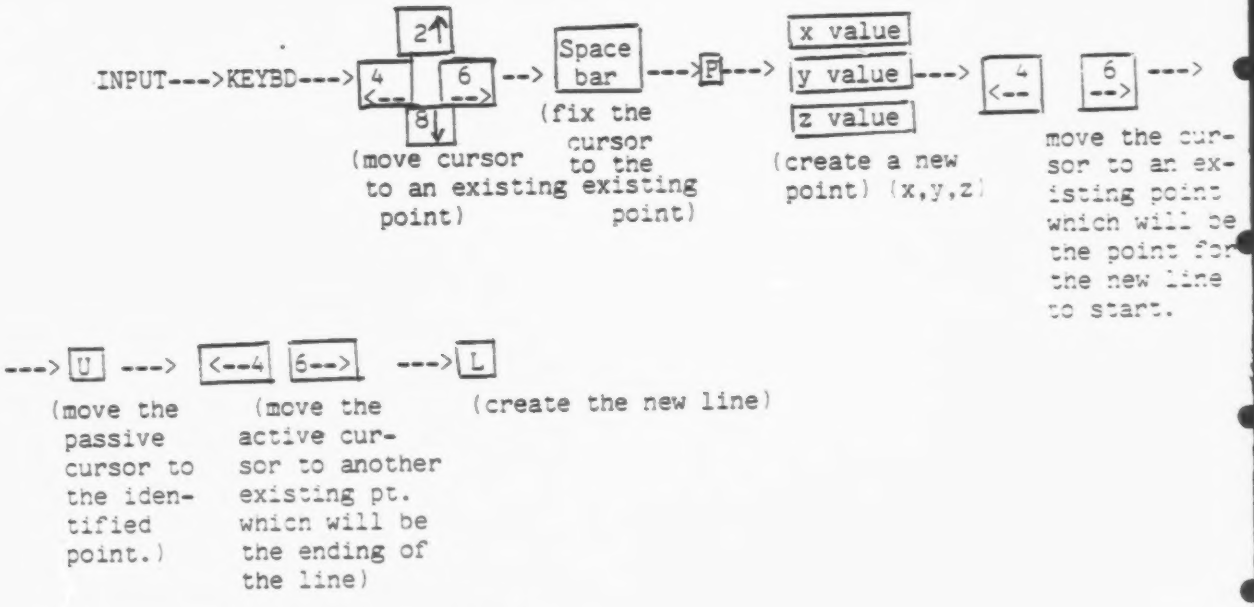
Letter P: creating a point (after you enter the x,y,z values)

Letter L: line will be drawn between points (only after the P function)
(from the passive cursor location to the active cursor location)

** Index numbers will be assigned,once a point or a line is drawn.

unite the ACTIVE and PASSIVE cursors.

Left Arrow: 4	Moves the ACTIVE cursor sequentially to the point of the drawing with the next lowest index.
Right Arrow: 6	Moves the next highest index point.
Letter E;	Erases the line between current positions of the ACTIVE & the PASSIVE cursors.
Letter D:	Deletes the point of the ACTIVE cursor located, and all lines connected to this point.
Letter X, Y, Z:	Changes the current ACTIVE cursor point X, Y, Z values individually. (Enter value after one of the letters are pressed)


INPUT--->KEYBD--->
2↑
4 <--
6 -->
8↓
-->
Space bar
--->P--->
x value
y value
z value
--->
4 <--
6 -->
--->
(move cursor to an existing point)
(fix the cursor to the existing point)
(create a new point) (x,y,z)
move the cursor to an existing point which will be the point for the new line to start.
---> U --->
<--4
6-->
---> L
(move the passive cursor to the identified point.)
(move the active cursor to another existing pt. which will be the ending of the line)
(create the new line)

Display data: (USER coordinates)

PT3, X - 2.29, Y 2.56, Z 1.44

DX	DY	DE	2-D	3-D
0.47	3.76	1.28	3.79	4.00

ACTIVE & PASSIVE Linear Measure

may not be a true measure

always a true distance.

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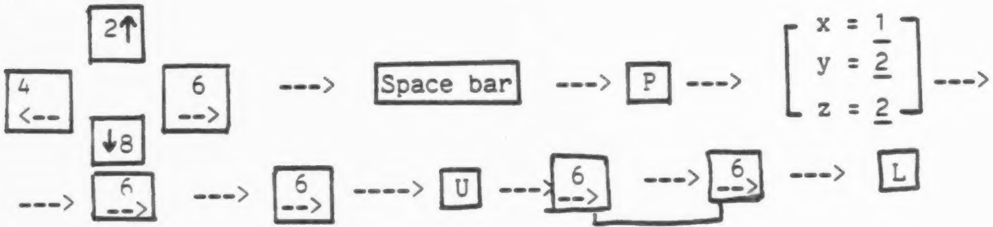
* Number at the upper LEFT hand corner of the screen is the index number of the drawing in which the ACTIVE cursor is located.

* The number at the upper RIGHT hand corner is the index number of the active drawing.

Example 1:

1. FILES ------------>LOAD C2. GRA
2. INPUT ------------>KEYBD



until the active cursor moves to the new created point.

INPUT : GRID

* Set the size of the imaginary GRID.

* Default GRID spacing = 0.001

* It is easy to draw lines straight if they are paralleling to the 3 axes.

* It is easy to locate a point previously set.

INPUT : T - SCALE

Tablet Scale: set the relationship between the Tablet Scale and the USER coordinates.

For example:

1 inch on the tablet = 1 unit on the USER coordinates

1" = 2.5 units (for metric measurement)

1" = 0.5 units DOUBLE SIZE for representation (USE IT WHEN THE OBJECT IS TOO SMALL.)

1" = 2 units ONE HALF SIZE for representation (USE IT WHEN THE OBJECT IS TOO LARGE.)

Default: 1" = 1 unit (1)

REMEMBER:

USER = TABLET * T - SCALE

SCREEN = USER * ZOOM

screen = TABLET * T - SCALE * ZOOM

(DEFAULT ZOOM (20): 1 USER UNIT WILL TAKE 20 PIXELS)

EXAMPLE:

A cube has a base size of ¼ of a tablet size.

IF (1) T-SCAL = 1

regular display will take ¼ of the screen.

for full screen visual display, you should enlrage it

to 4 times (2 on each axis)

Since the default is 20 for ZOOM, therefore, 4 x 20 = 80 should

be used as the ZOOM factor.

IF (2) T - SCAL = 2

You double the USES value form the tablet movement.

1" move --------- 2 units of USER

Therefore no enlargement is needed to cover the max. screen space.

1 x 20 = 20 is the ZOOM factor.

INPUT : ARC

Three input elements:

(1) ARC center
(2) ARC radius
(3) ARC angle

Possible input devices:

(1) TAB 3-D
(2) TAB 2-D
(3) KEYBD

A new file names ARC will be assigned after the ARC is drawn.

1. INPUT -----→ARC

(center)	(TAB -3D)	(Position the active cursor) (SPACE BAR)
(radius)	(TAB 3D)	(Position the active cursor) (SPACE BAR) (This is also the point the arc starts)
(angle)	(270°)	(This value can be + or -)
(verticis)	(20)	20 or more makes a smooth arc)

2. INPUT-------→ARC

(center)	(TAB 2D)	(SPACE BAR)
(radius)	(TAB 2D)	(SPACE BAR)
(angle)	(300°)	
(verticis)	(15)	

3. INPUT--------→ARC

(center)	(KEYBD)	X(2), Y(3)
(radius)	(KEYBD)	(2)
(angle)	(180°)	
(starting point)		X(2) Y(1)
(verticis)	(20)	

INPUT : DOUBLE (Mirror, Simple, Joined)

* Generate duplicate drawing(s) of current ACTIVE file.

* Example applications:

a. The mirror function will be most useful to construct a symmetical object.

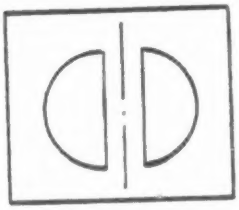
b. Simple is to make multiple exact copies.

c. Joined can make a cylinder or a cube in a simple way.

1. INPUT --------→DOUBLE

MIRROR (make a mirror image of the last drawing- semi circle)

Screen:



T-FORM MOV X(_) (only X axis moves, use the same value of the X-coordinate of the arc starting point)

FILES ------→CHOOSE (ALL)

2. INPUT ---------→DOUBLE

SIMPLE

T-FORM----→MOV X(-1)

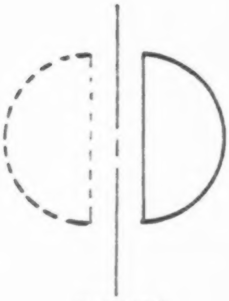
Y(-2)

3. INPUT -------- DOUBLE

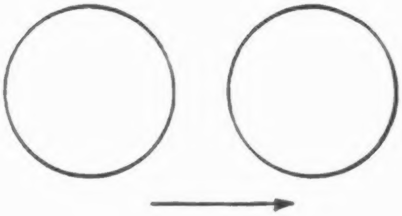
JOINED

T-FORM-----MOV X(+2)

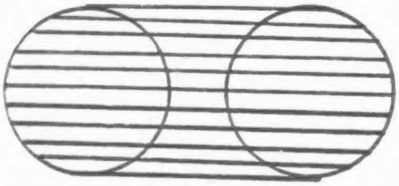
Y(+1)



MIRROR



SIMPLE MOV



JOINED MOV

* A new file named DOUBLE will be assigned.

Top: Left half of a human skull digitized with the SPACE TABLET™.
Middle: The left half has been DOUBLEd using the MIRROR function to give the right half. The MIRROR function permits you to digitize only half of a symmetric object.
Bottom: Both halves have been manipulated to form the composite.

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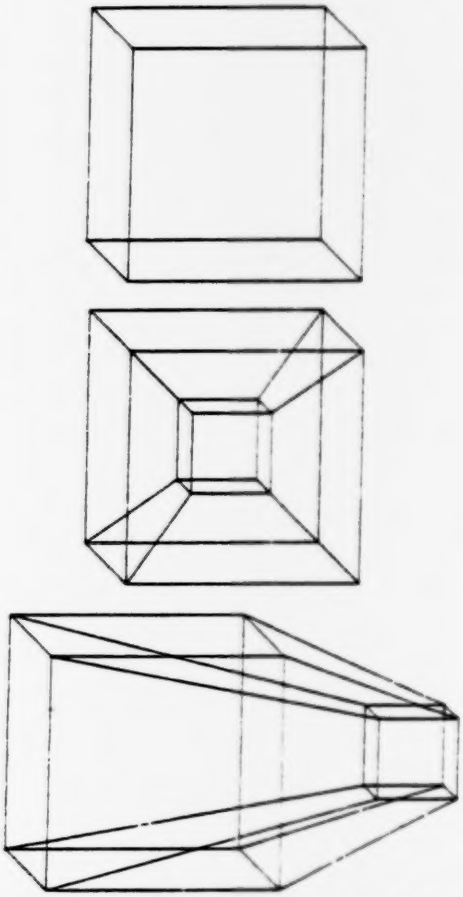
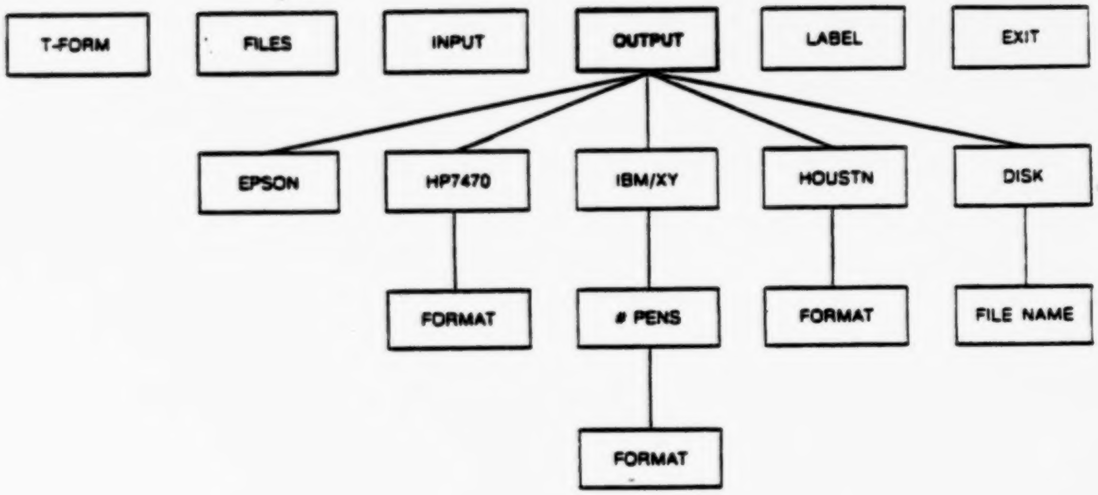


Top: The cube (C2.GRA) DOUBLEd using the JOINED function (the duplicate initially overlaps the original and hence is not visible).
Middle: The duplicate has been SCALEd down to show the connecting lines.
Bottom: The duplicate has been MOVEd. The connecting lines have stretched accordingly - a process known as "rubber banding".


T-FORM
FILES
INPUT
OUTPUT
LABEL
EXIT
EPSON
HP7470
IBM/XY
HOUSTN
DISK
FORMAT
# PENS
FORMAT
FILE NAME
FORMAT

Tree 4

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DEPARTMENT OF INDUSTRIAL TECHNOLOGY

HIGH TECHNOLOGY MOBILE LABORATORY

Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 11

LAP TITLE: CADD Function - Output Methods (OUTPUT)

PREREQUISITE LAP (S) : CADD 10

LAP PURPOSE: To practice the two hardcopy generation methods: (1) the flat bed pen plotting and (2) the dot matrix printing.

COMPETENCIES TO BE DEVELOPED:

1. To produce a drawing hardcopy via the Houston DMP 29 pen plotter.
2. To produce a drawing hardcopy by using the Epson MX-80 printer.
3. To use the screen dump function to print out graphic data listing with the Epson printer.

OUTPUT:
(OUTGRAPH ONLY)

Warning: If the OUPUT function is choosen from INGRAPH, you must save the drawing first, otherwise the drawing will be erased.

Mobile IN Laboratory : (1) EPSON

(2) HOUSTON DMP 29

1. OUTPUT---------→EPSON

   * This is a screen dump function (whatever you see on the screen will be printed exactly)

   * To make the printer ready:

     power switch

     on line

     form feed

     line feed

2. OUTPUT--------------→HOUSTON (RESET the plotter first)

   * This function will plot an assigned scale drawing by the HOUSTON pen plotter.

   * To make the plotter ready:
     Power switch
     Pen

   *For small "size A" plot: Press Reset → → Local → Small Chart → Remote (make sure use the OUTGRAPH which has been configurated to the small chart).

In Addition:

---

3. Graphic print-out on EPSON without using the OUTPUT of OUTGRAPH

   a. Before running INGRAPH or OUTGRAPH, insert the DOC 2.0 disk and run it to system level.
   A > GRAPHICS

   b. Run INGRAPH or OUTGRAPH

   c. Get the desired drawing onto the screen.

d. Press ⇧ + PrtSc and you will get a print out from the EPSON printer

* If you didn't run the DOS GRAPHICS at the beginning, you must SAVE your drawing first then start the whole sequence.

4. Text display print out:

   1. Get the desired text onto the screen
   2. Press ⇧ + PrtSc and you will get a print out

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Learning Activity Packet

MAJOR INSTRUCTIONAL UNIT: COMPUTER AIDED DESIGN/DRAFTING

LEARNING ACTIVITY PACKET (LAP) NUMBER: CADD 12

LAP TITLE: CADD Function - dimensioning and Documenting (LABEL)

PREREQUISITE LAP (S) : CADD 11

LAP PURPOSE: To study and practice the automatic dimensioning and the text labeling techniques.

COMPETENCIES TO BE DEVELOPED:

1. To dimension distances and angles to a drawing with both the index and the cursor methods.
2. To label texts at designated location on a drawing.
3. To modify or change existing dimensions and texts.
4. To save dimensions and texts onto a data disk.
5. To retrieve the label file and be used with the appropriate drawing.

TO MAKE A COMPLETE PRINTOUT OF A DRAWING'S OR A LABEL'S FILE LIST

Method I: use the OUTPUT function of the OUTGRAPH disk.

1. Run the OUTGRAPH to operational level.
2. FILE----->LOAD: (file name)
3. FILE----->LIST (TOTAL)
4. To stop scrolling press ENTER

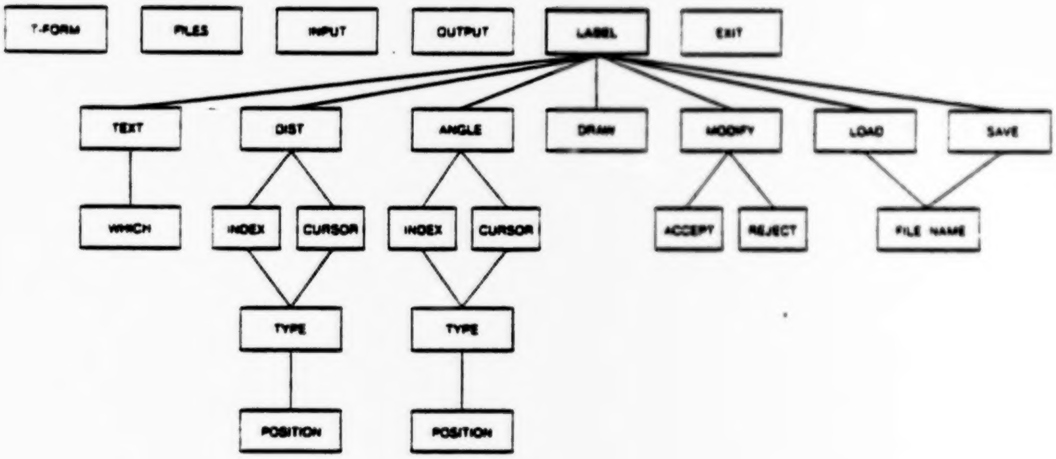
   (In most cases, the listing is too long, you may need to do the list printout part by part)

5. OUTPUT------>EPSON to obtain the printout of whatever is displayed on the screen
6. Repeat steps 3-5 for the remaining parts of the file list as many times as you need.

Method II: use the screen dump function of the IBM PC.

1. Follow the same steps mentioned above from 1 to 4.
2. Press ⇧ (shift) + PrtSc to obtain the printout of whatever is displayed on the screen.
3. Repeat steps 1 and 2 for the remaining parts of the file list.

** No DOS GRAPHICS should be run at beginning



Tree 5

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LABEL (text, dist, angle, draw, modify, load, save)
(OUTGRAPH only)

Warning: If the LABEL function is choosen from INGRAPH, you must save the drawing first, otherwise the drawing will be erased.

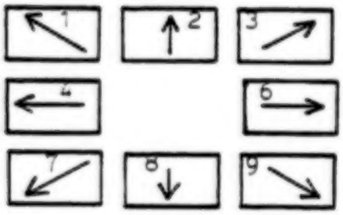
LABEL : TEXT

1. Insert the OUTGRAPH and run it to operational level.
2. FILES ------→ERASE (ALL)
3. FILES------→LOAD : C2. GRA (a cube)
4. LABEL -------→ TEXT

   (type in desired TEXT: CUBE DEMO TRY)

   (the screen will show: CUBE DEMO TRY SPACE = Locate

   and ▨ flashing



or TAB or uppercase TAB

← →

SPACE BAR to fix the location

5. If you would like to make the label permanent do this:

   LABEL -------→ DRAW

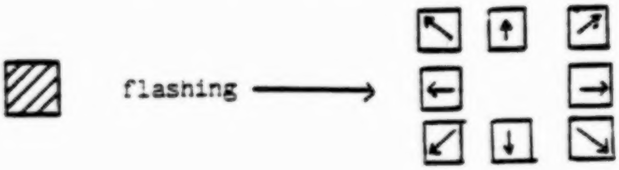
LABEL: DIST

To locate and label distance between points on a given drawing. (automatically calculated)

METHODS:

(I) INDEX method:

- A. Locate two points for distance:
  - a. Enter initial point index number
  - b. `SPACE BAR` TO accept the point, or
  - c. If you want to move the inital point to other place, you can use `←` or `→` to move cursor to next lowest or next highest pt. index point.
  - d. `SPACE BAR` to accept the point.
  - e. Repeat the second point selection with steps a-d.
- B. Kind of distance needed:
  - a. The screen will prompt: (1) X, (2) Y, (3) Z, (4) 2-D, (5) 3-D
    - (i) X,Y,Z measure distance parallel to the X,Y,Z axes.
    - (ii) 2-D measures distance in the plane of the screen. (This may not be a true measure)
    - (iii) 3-D measure the true 3 dimensional distance. (unchanged by transformations)
    - *(i)(ii) will be changed when the drawing is subject to a transformation.
  - b. `SPACE BAR`
- C. Locate the dimension (label) position:
  - a.



or TAB or uppercase TAB

  - b. SPACE BAR to locate the position

1. LABEL--------→DIST--------→(INDEX) try to label a couple of dimensions

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(II) CURSOR method:

(II)CURSOR method

A. ▨ flashing ⟶ ↖ ↑ ↗ ← → ↙ ↓ ↘ or TAB or uppercase TAB

to get near to a given point

B. SPACE BAR to locate the initial point , **or**

C. ← , → move to the next lowest or highest point Pt. index point (If the previous **point** is not desired.

D. SPACE BAR to locate the point

E. YES (validate the point)

F. Locate the second point in the **same** manner.

G. Type the measurements selection X,Y,Z, OR 2-D or 3-D

H. Locate the dimensions (label) position.

2. LABEL --------→DIST ------→(CURSOR)

Try to label a couple dimensions.

LABEL : ANGLE

To dimension the angle between USER specified line segments of a drawing. (automatically calculated)

Methods:

(I) INDEX method:

A. Locate two lines for an angle measure.

a. Enter the initial index number of the first line, or

b. ← , → moves to the next LOWEST or HIGHEST line index value.

c. SPACE BAR to accept the line.

d. Repeat steps a-c to accept the second line.

B. Types of angles:

a. The screen will promptly display: (1)X, (2)Y, (3)Z, (4) 3-D

(i) X, Y,Z will calculate the angle according to X,Y, Z planes respectively.

(ii) 3-D measures the true angle, as it is in the real 3-D world. (unchanged in any T-Form)

C. Locate the dimension (label) position:

a. ▨ flashing

↖ ↑ ↗
← →
↙ ↓ ↘ or TAB or uppercase TAB

b. SPACE BAR to locate the position

1. LABEL ------→ANGLE-------→(INDEX)

Try to label an angle.

(II) CURSOR method:

A. ▨ flashing ↖ ↑ ↗ ← → ↙ ↓ ↘ or TAB or uppercase TAB

to move the cursor near to an end point of one of the lines.

B. SPACE BAR to locate the line, or

C. → to choose the other line of the angle.

D. SPACE BAR to locate the line

E. If the endpoint of the line is undesired.

F. SPACE BAR to get free from the earlier selection.

G. ←, → move to the next lowest or highest index line.

H. SPACE BAR to lcoate the line.

I. Locate the second line as you did for the first line.

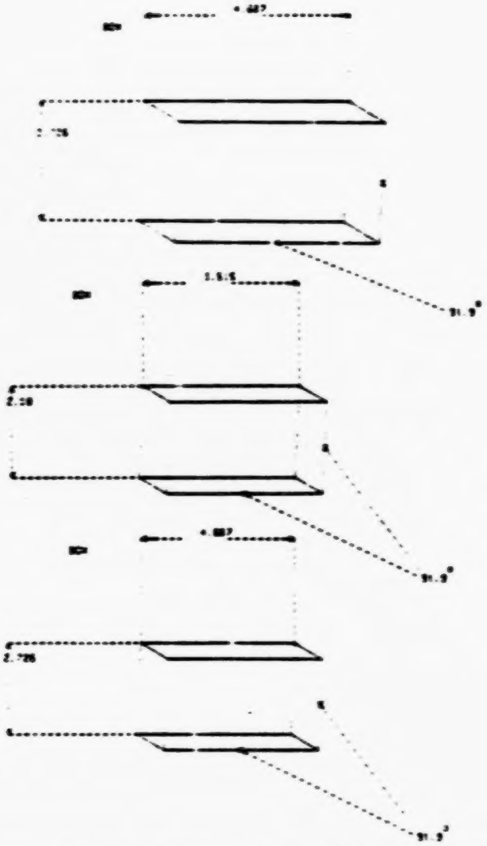
J. Type of angles:

X, Y, Z or 3-D

K. Locate the dimension (label) positions.

2. LABEL ------→ANGLE----→(CURSOR)

Try to label a couple of angles.



Top: A box has been automatically LABELed using a LABEL FILE stored on disk.
Middle: The box has been SCALEd down and re-LABELed using the same LABEL FILE. Since SCALing changes the coordinates, the distances (but not the angle) change accordingly.
Bottom: The original box has been reduced in size visually using the ZOOM function and then re-LABELed using the same LABEL FILE. Since ZOOM does not alter the coordinates, the LABELS remain unchanged.

LABEL : DRAW

Drawings and labels are operated seperately. In order to include drawings and labels together for a complete set you need to use DRAW.

```
1. LABEL-------->DRAW
```

LABEL : MODIFY

The function of MODIFY is two-fold:

(1) Verify one label at a time. If it is accepted the label will be redrawn with the drawing. If it is rejected, the label will be deleted.

(2) When all labels have been cycled through, the drawing will be redrawn complete with those LABELS that were accepted.

```
1. LABEL------->MODIFY------->(ACCEPTED)
                              (REJECTED)
```

LABEL : LOAD

To load a label file previously saved for matching a particular drawing.

* Make sure they are exactly matched. (T-Form of a drawing may make the early labels unmatched.)

```
1. FILE------>ERASE
   FILE------>LOAD: C3.GRA
  LABEL------>LOAD: C3. LAB       (DIRECT  can be used to check LABEL file names)
```

LABEL:SAVE

To save a label file which was created for a particular drawing:

*Assign a name to the label file.

* The saved file will only contain a set of labels.

* A good practice to assign file names suggests to:

(1) Use the same name for the drawing file and the matched label file.

(2) Name the DRAWING with a " .GRA " suffix appended to the file name.

(3) Name the LABEL with a " . LAB " suffix appended to the file name.

Computer Graphics

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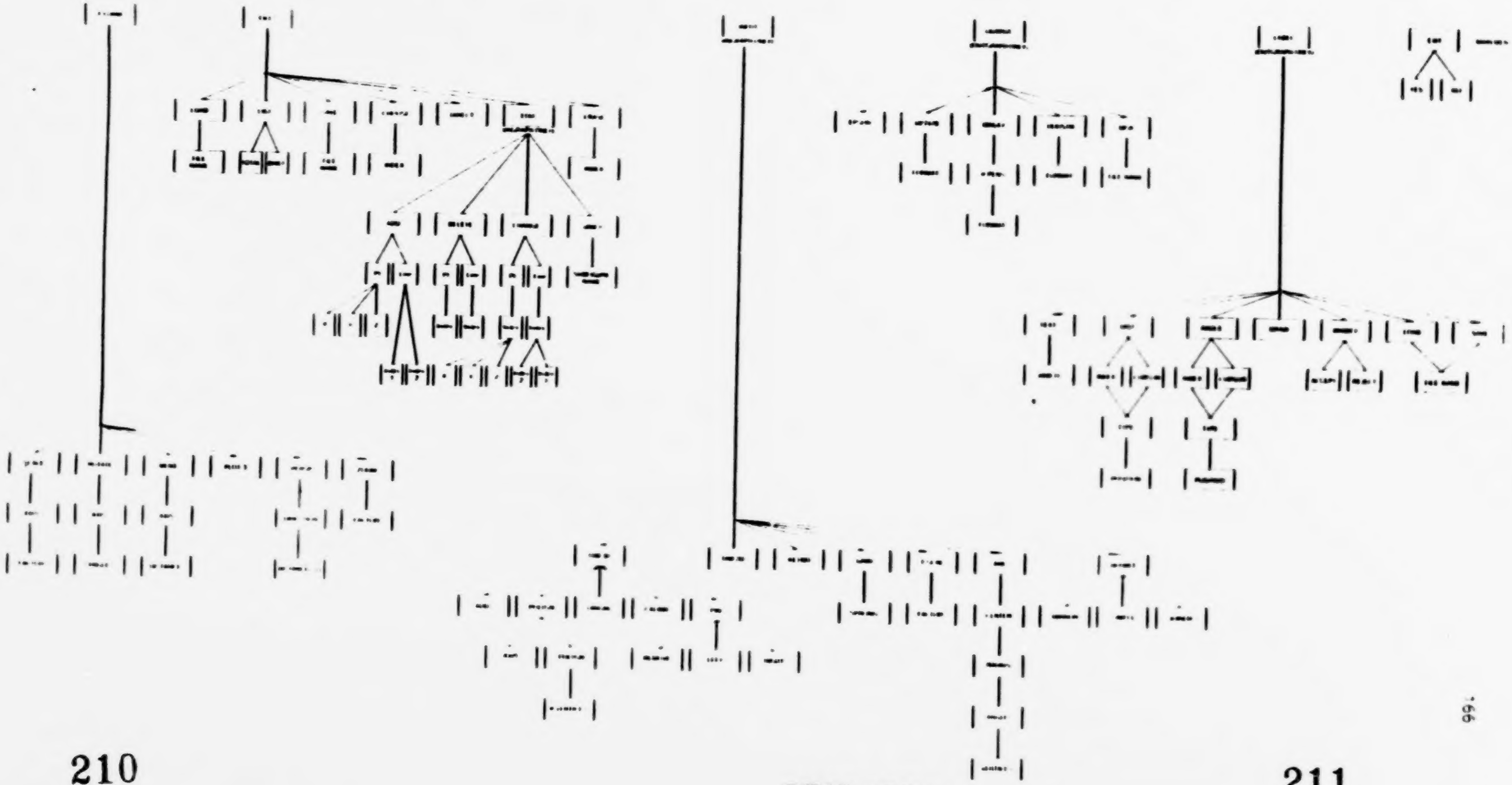
Compiled by: Dr. Wan-Lee Cheng

February 28, 1985



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Group Activity 1
Major Functions Practice

1. Review the section which is assigned to your group.
2. Study the manual about detail functions of that section.
3. Demonstrate the assigned section to entire class. (you may use the LAP and follow the procedures).
4. Study and practice the INPUT functions.

Group 1:

Calibration of 3-D tablet

INPUT

Group 2:

T-Form

INPUT

Group 3:

Files

INPUT

Group 4:

Label

INPUT

Group Activity 2
2-D Tablet Input

1. Use the MCS 2-D Tablet to generate a drawing which is assigned to your group.
2. Save the drawing on a provided data disk.
3. Plot the drawing via the Houston DMP-29 plotter.

Group 1:

Problem 1

Group 2:

Problem 2

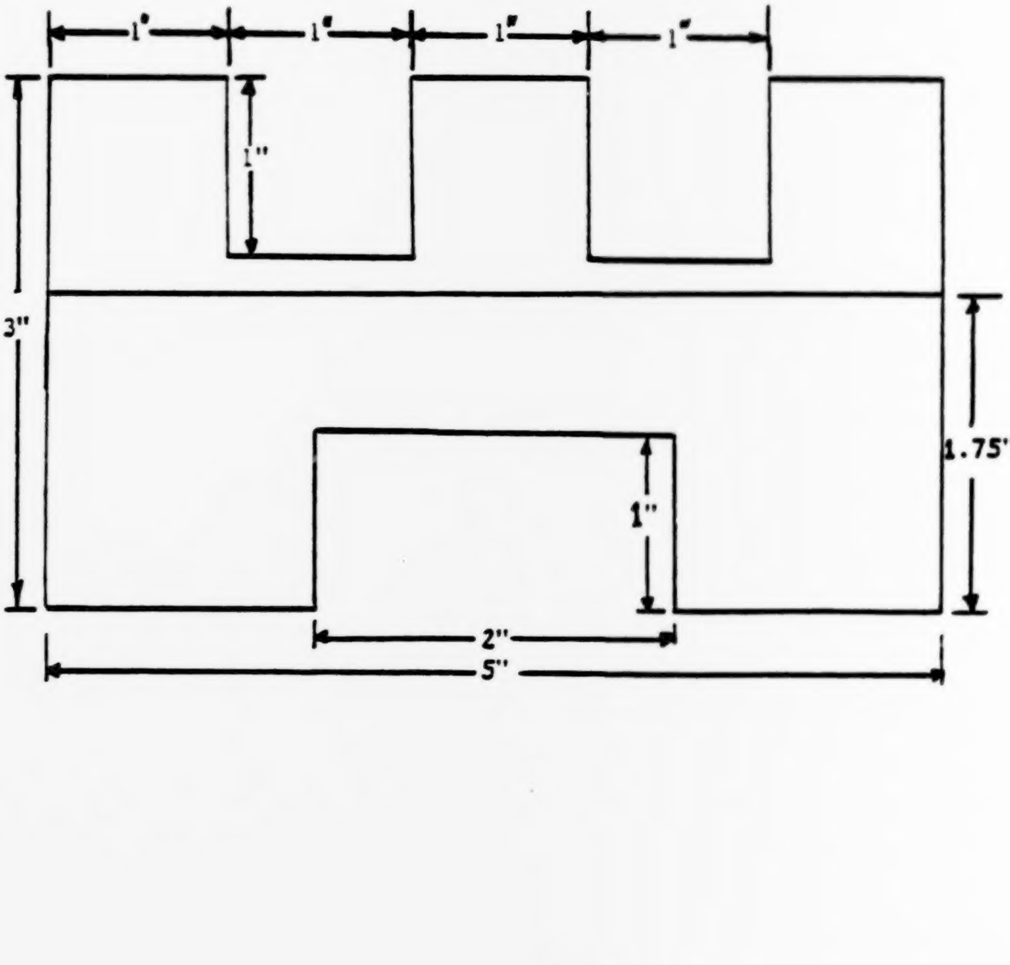
Group 3:

Problem 3

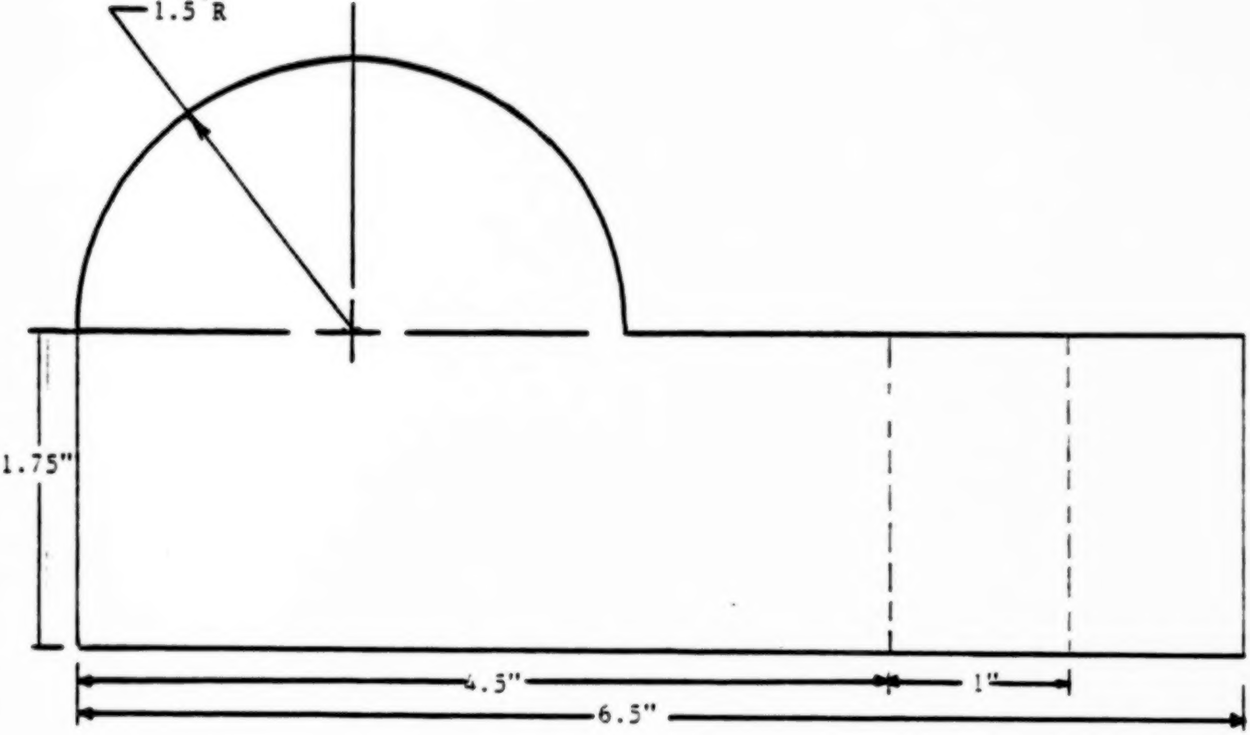
Group 4:

Problem 4

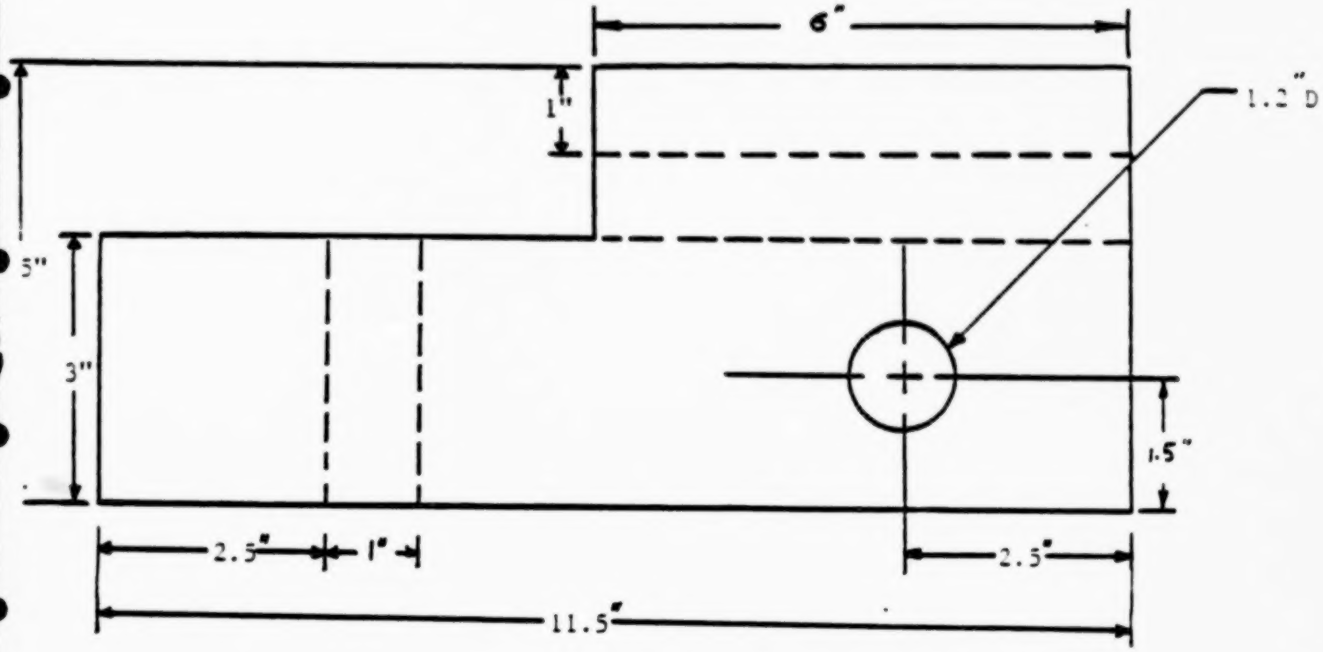
PROBLEM 1



PROBLEM 2

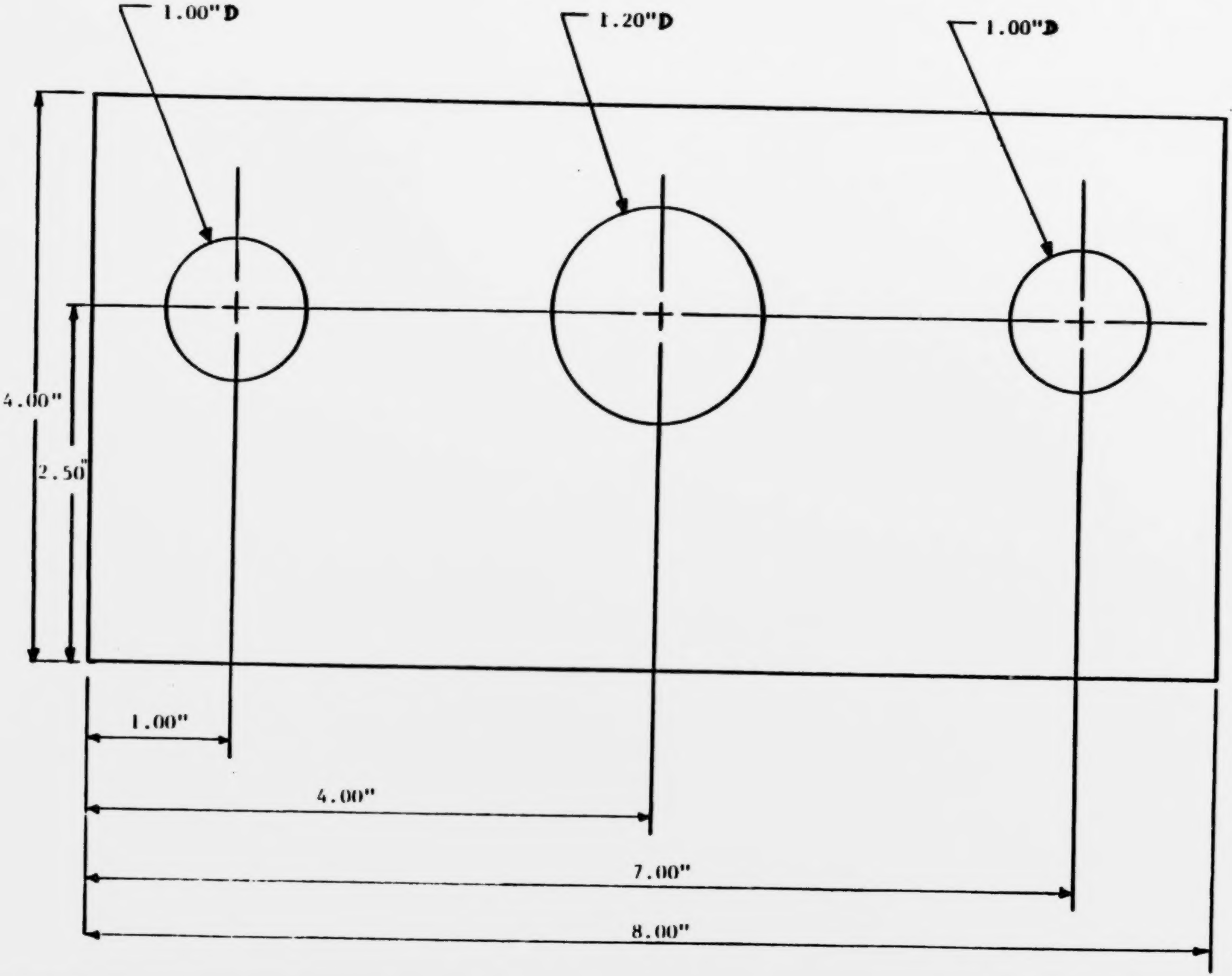


PROBLEM 3



SCALE : 1/2

Problem 4



Group Activity 3
3-D Tablet Input

1. Create a drawing by using a given model with the 3-D Space Tablet.
2. Practice T-FORM functions, such as ROTATE, MOVE, etc.
3. Save the drawing on a provided data disk.
4. Retrieve the drawing and add texts and dimensions to the graph.
5. Save the text and dimensions on the same data disk.
6. Printout the data list with the Epson printer.
7. Plot the complete drawing on the Houston DMP-29 plotter. (both normal and plot - 3)

Group 1:

Wood rectangular cube

Group 2:

Styrofoam disk

Group 3:

Styrofoam cone

Group 4:

Hollow cylinder

Wood Rectangular Cube

1. $\boxed{F_3}$ input
2. $\boxed{F_1}$ Tab-3D, $\boxed{F_1}$ add
3. $\boxed{F_3}$ Cur. C.
4. Move the pointer to one of the corners (use either the base or the top.
5. Make sure to use the base or the top, as you selected for the #4 step.
6. $\boxed{F_1}$ line

   $\boxed{F_1}$ line

   $\boxed{F_1}$ line

   $\boxed{F_4}$ join

   $\boxed{F_{10}}$
7. $\boxed{F_9}$ go back to **MAIN** menu
8. $\boxed{F_3}$ input
9. $\boxed{F_7}$ double, F_3 joined
10. $\boxed{F_9}$ go back to **MAIN** menu
11. $\boxed{F_1}$ T-form
12. $\boxed{F_3}$ move
13. $\boxed{F_3}$ Z

    --> move value (actual measure of the height)

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14. $\boxed{F_9}$ go back to **MAIN** menu

15. $\boxed{F_2}$ file

16. $\boxed{F_4}$ choose all

17. $\boxed{F_5}$ all

18. save RECUBE

Play Doh Can - Styrofoam Disk

1. $\boxed{F_3}$ input
2. $\boxed{F_1}$ Tab - 3D
3. $\boxed{F_2}$ Polygon
4. $\boxed{F_1}$ Axis
5. Locate the pointer to the center and push the space bar to identify the axis.
6. $\boxed{F_2}$ Polygon
7. Locate to top edge
8. ---> # of vertices ----> enter value.
9. $\boxed{F_2}$ Polygon
10. Bottom edge
11. $\boxed{F_{10}}$ Exit the polygon function
12. $\boxed{F_9}$ Back to main menu
13. $\boxed{F_2}$ file
14. $\boxed{F_4}$ Choose all
15. SAVE CYLIND

Styrofoam Cone

1. $\boxed{F_3}$ input
2. $\boxed{F_1}$ Tab-3D
3. $\boxed{F_2}$ Polygon
4. $\boxed{F_1}$ Axis
5. locate to center of the top circle identify axis.
6. $\boxed{F_2}$ Polygon
7. Locate to the top edge
8. enter number of vertices (20)
9. $\boxed{F_2}$ Polygon
10. $\boxed{F_{10}}$ Exit the polygon function
11. $\boxed{F_9}$ Back to main menu.
12. $\boxed{F_2}$ file
13. $\boxed{F_4}$ choose ----> all
14. Save CONE

Hollow Cylinder

1. $\boxed{F_3}$ Input
2. $\boxed{F_1}$ Tab-3D
3. $\boxed{F_2}$ Polygon
4. $\boxed{F_1}$ Axis
5. Locate the pointer to the center and push the space bar to identify the axis.
6. $\boxed{F_2}$ Polygon
7. locate to top inside edge
8. ---→ # of vertices ----> enter value <hit return>
9. $\boxed{F_2}$ Polygon
10. Locate to top outside edge $\boxed{\text{space}}$ -----→ bottom outside edge $\boxed{\text{space}}$ ----→ bottom---inside edge $\boxed{\text{space}}$ -----→ top inside edge $\boxed{\text{space}}$
11. $\underline{F_{10}}$ Exit the polygon function
12. $\boxed{F_9}$ Back to main menu
13. $\boxed{F_2}$ File
14. $\boxed{F_4}$ Choose all
15. Save HOLCYL

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